

TECHNICAL MANUAL  
FOR  
[*SGML VERSION; SEE CHANGE  
RECORD*]  
**CHAMPION PORTABLE FIRE  
PUMP  
P-100 (2BE10YDN)**

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**RECORD OF CHANGES**

CHANGE	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY
REVISION 1	1 OCTOBER 2003	ENGINE CONFIGURATION CHANGES DUE TO YANMAR L100EE REPLACING L100AE MODEL ENGINES.	GALLAGHER
		PUMP CONFIGURATION CHANGES DUE TO PUMP DISCHARGE HEAD REPLACEMENT.	
		NOTES SPECIFIC TO NAVY USERS ADDED TO DIFFERENTIATE FROM COMMERCIAL USER GUIDANCE.	
<p>NOTE</p> <p>THIS TECHNICAL MANUAL (TM) HAS BEEN DEVELOPED FROM AN INTELLIGENT ELECTRONIC SOURCE KNOWN AS STANDARD GENERALIZED MARKUP LANGUAGE (SGML). THERE IS NO LOEP. ALL CHANGES, IF APPLICABLE, ARE INCLUDED. THE PAGINATION IN THIS TM WILL NOT MATCH THE PAGINATION OF THE ORIGINAL PAPER TM; HOWEVER, THE CONTENT IS EXACTLY THE SAME. ANY CHANGES RECEIVED AFTER RECEIPT OF THIS TM WILL ONLY FIT IN THIS PAGINATED VERSION.</p>			



## FOREWORD

This technical manual provides operation, maintenance, and repair instructions with a parts list for the P-100 (2BE10YDN) Portable Pump Unit. The pump is manufactured by W. S. Darley & Co., Melrose Park, IL 60160. The technical manual covers the following chapters:

**CHAPTER 1**, GENERAL INFORMATION AND SAFETY PRECAUTIONS

**CHAPTER 2**, Operation

**CHAPTER 3**, Functional Description

**CHAPTER 4**, Troubleshooting

**CHAPTER 5**, Scheduled Maintenance

**CHAPTER 6**, Corrective Maintenance

**CHAPTER 7**, Parts List

**CHAPTER 8**, Warranty

**APPENDIX A**, Commercial User Scheduled Maintenance

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## **SAFETY SUMMARY**

### **GENERAL SAFETY NOTICES**

The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein. Should situations arise that are not covered in the general or specific safety precautions, the commanding officer or other authority will issue orders as deemed necessary to cover the situation. No work shall be undertaken on energized equipment or circuits until approval of the commanding officer is obtained, and then only in accordance with Naval Ships Technical Manual (NSTM) S9086-KC-STM-010/Chapter 300.

### **DO NOT REPAIR OR ADJUST ALONE**

Under no circumstances shall repair or adjustment of energized equipment be attempted alone. The immediate presence of someone capable of rendering aid is required. Before making adjustments, be sure to protect against grounding. If possible, adjustments should be made with one hand, with the other hand free and clear of equipment. Even when power has been removed from equipment circuits, dangerous potentials may still exist due to retention of charges by capacitors. Circuits must be grounded and all capacitors discharged prior to attempting repairs.

### **TEST EQUIPMENT**

Make certain test equipment is in good condition. If a metal-cased test meter must be held, ground the case of the meter before starting measurement. Do not touch live equipment or personnel working on live equipment while holding a test meter. Some types of measuring devices should not be grounded; these devices should not be held when taking measurements.

### **MOVING EQUIPMENT**

Personnel shall remain clear of moving equipment. If equipment requires adjustment while in motion, a safety watch shall be posted. The safety watch shall have a full view of the operations being performed, and immediate access to controls capable of stopping equipment motion.

### **FIRST AID**

An injury, no matter how slight, shall never go unattended. Always obtain first aid or medical attention immediately, and file an injury report in accordance with OPNAVINST 5102.1, Mishap Investigation and Reporting.

### **RESUSCITATION**

Personnel working with or near high voltages shall be familiar with approved methods of resuscitation. Should someone be injured and stops breathing, begin resuscitation immediately. A delay could cost the victim's life. Resuscitation procedures shall be posted in all electrically hazardous areas.

The following Warnings and Cautions appear in the text and are repeated here for emphasis.

**SAFETY SUMMARY - Continued**

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**WARNING**

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Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed. (Page 1-1)

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**WARNING**

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THE PUMP UNIT IS DESIGNED TO GIVE SAFE AND DEPENDABLE SERVICE PROVIDED THAT IT IS OPERATED ACCORDING TO INSTRUCTIONS. READ AND UNDERSTAND THE OPERATION MANUAL BEFORE OPERATING THE PUMP UNIT FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR EQUIPMENT DAMAGE. (Page 1-1)

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**WARNING**

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UNLESS IT IS A DIRE EMERGENCY, NEVER ADD FUEL TO THE FUEL TANK WHILE THE ENGINE IS RUNNING. WHEN EMERGENCY REFUELING BECOMES NECESSARY, A SECOND PERSON SHALL STANDBY WITH AN APPROPRIATE FIRE EXTINGUISHER. WIPE AWAY ALL FUEL SPILLS WITH A CLEAN CLOTH. KEEP GASOLINE, KEROSENE, HATCHES AND OTHER EXPLOSIVES AND INFLAMMABLES AWAY FROM THE ENGINE, BECAUSE THE TEMPERATURE AROUND THE EXHAUST MUFFLER IS VERY HIGH DURING OPERATION. (Page 1-1)

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**WARNING**

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TO PREVENT FIRE HAZARDS AND TO PROVIDE ADEQUATE VENTILATION, KEEP THE PUMP UNIT AT LEAST THREE FEET (1 M) AWAY FROM BUILDINGS AND OTHER EQUIPMENT DURING OPERATION. (Page 1-2)

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**WARNING**

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OPERATE THE PUMP UNIT ON A LEVEL SURFACE AS FAR AS POSSIBLE. THE ALLOWABLE INCLINATION OF THE ENGINE FOR CON-

**TINUOUS USE IS WITHIN 20 DEGREES. THERE MAY BE FUEL SPILLAGE IF THE ENGINE IS TILTED BEYOND THAT LIMIT. (Page 1-2)**

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**WARNING**

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**DO NOT PUT THE PUMP UNIT INDOORS WHILE THE ENGINE IS STILL HOT. (Page 1-2)**

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**WARNING**

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**EXHAUST GAS CONTAINS POISONOUS CARBON MONOXIDE. NEVER USE THE PUMP UNIT IN POORLY VENTILATED LOCATIONS, SUCH AS INDOORS AND INSIDE TUNNELS. IF INDOOR OPERATION IS UNAVOIDABLE, PROVIDE PROPER VENTILATION AND USE AN APPROVED EXHAUST HOSE ROUTED TO WEATHER. (Page 1-2)**

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**WARNING**

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**NEVER TOUCH THE MUFFLER, MUFFLER COVER OR ENGINE BODY WHILE THE ENGINE IS RUNNING OR HOT. (Page 1-3)**

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**WARNING**

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**NEVER TOUCH THE HOT EXHAUST HOSE WHEN OPERATING THE PUMP UNIT WITHOUT USING FIREFIGHTER'S GLOVES. EXHAUST HOSE TEMPERATURES MAY CAUSE BURNS ON UNPROTECTED HANDS. (Page 1-3)**

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**WARNING**

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**KNOW HOW TO STOP THE ENGINE QUICKLY AND UNDERSTAND HOW TO OPERATE ALL OF THE CONTROLS. NEVER PERMIT ANYONE TO OPERATE THE ENGINE WITHOUT PROPER INSTRUCTION. (Page 1-3)**



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**WARNING**

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**KEEP AWAY FROM ROTATING PARTS WHILE THE ENGINE IS RUNNING. (Page 1-3)**

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**WARNING**

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**READ OPERATING INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO OPERATE THE PUMP UNIT! (Page 2-1)**

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**WARNING**

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**DO NOT OPERATE THE PUMP UNIT IN CONFINED SPACES UNLESS THE EXHAUST HOSE IS CONNECTED TO CARRY THE TOXIC ENGINE EXHAUST GASES TO WEATHER. (Page 2-3)**

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**WARNING**

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**HEARING PROTECTION IS REQUIRED IN THE IMMEDIATE AREA OF THE PUMP UNIT WHILE IN OPERATION. (Page 2-3)**

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**WARNING**

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**SHUT OFF THE ENGINE BEFORE PERFORMING ANY MAINTENANCE. IF THE ENGINE MUST BE RUN, MAKE SURE THE AREA IS WELL VENTILATED. THE EXHAUST CONTAINS POISONOUS CARBON MONOXIDE GAS. (Page )**

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**WARNING**

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**DIESEL FUEL AND JP-5 VAPORS ARE COMBUSTIBLE. WHEN WORKING ON ANY PART OF FUEL SYSTEM, PROVIDE ADEQUATE VENTILATION AND AVOID HIGH HEAT AND OPEN FLAME. (Page )**

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**WARNING**

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**ENGINE SURFACES WILL BE HOT IMMEDIATELY AFTER SECURING THE PUMP. ALLOW SUFFICIENT TIME FOR EXTERNAL SURFACES TO COOL BEFORE HANDLING HOT ENGINE COMPONENTS. (Page )**

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**WARNING**

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**THE ENGINE MAY BE DAMAGED IF OPERATED WITH INSUFFICIENT LUBE OIL. IT IS ALSO DANGEROUS TO SUPPLY TOO MUCH LUBE OIL TO THE ENGINE BECAUSE A SUDDEN INCREASE IN ENGINE RPM COULD BE CAUSED BY ITS COMBUSTION. ALWAYS CHECK THE LUBE OIL LEVEL BEFORE STARTING THE ENGINE AND REFILL IF NECESSARY. (Page )**

---

**WARNING**

---

**DO NOT OPERATE PUMP IN AN ENCLOSED AREA WITHOUT EXHAUST HOSE CONNECTED AND ROUTED SAFELY TO OUTSIDE ATMOSPHERE. EXHAUST GASES CONTAIN CARBON MONOXIDE, WHICH IS ODORLESS AND POISONOUS, AND CAN CAUSE INJURY OR DEATH WHEN INHALED. (Page , page , page )**

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**WARNING**

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**HIGH TEMPERATURES EXIST IN VICINITY OF EXHAUST HOSE CONNECTION AT ENGINE AND AT EXHAUST HOSE DISCHARGE. WEAR FIREFIGHTERS GLOVES AT ALL TIMES WHEN HANDLING EXHAUST HOSES. (Page , page )**

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**WARNING**

---

**PERSONNEL SHALL WEAR APPROVED HEARING PROTECTIVE DEVICES WHEN ENGINE IS OPERATING. (Page , page )**

---

**WARNING**

---

**F-76 AND JP-5 VAPORS ARE COMBUSTIBLE. WHEN WORKING ON ANY PART OF FUEL SYSTEM, PROVIDE ADEQUATE VENTILATION AND AVOID HIGH HEAT AND OPEN FLAME. (Page )**

---

**CAUTION**

---

**Indicates a possibility of personal injury or equipment damage if instructions are not followed. (Page 1-1)**

---

**CAUTION**

---

**ONLY USE THE CORRECT TOOLS AND EQUIPMENT. (Page 1-3)**

---

**CAUTION**

---

**WHEN CHECKING THE OIL LEVEL, MAKE SURE THAT THE PUMP UNIT IS SITTING LEVEL. IF IT IS TILTED, YOU MAY ADD EITHER TOO MUCH OR TOO LITTLE OIL. OVERFILLING THE RECOMMENDED OIL LEVEL MAY CAUSE THE ENGINE TO CONSUME TOO MUCH OIL AND THE OIL TEMPERATURE MAY BECOME DANGEROUSLY HIGH. OPERATION OF THE PUMP UNIT WITH THE OIL LEVEL BELOW THE RECOMMENDED LEVEL MAY CAUSE SEVERE DAMAGE TO THE ENGINE. (Page 2-1)**

---

**CAUTION**

---

**NEVER CHECK THE ENGINE LUBE OIL LEVEL WHILE THE ENGINE IS RUNNING. (Page 2-1)**

---

**CAUTION**

---

**THE SUCTION HOSE MAY REQUIRE SUPPORT TO PREVENT EXCESSIVE WEIGHT FROM STRESSING THE PUMP CASING, INBOARD HEAD, OR ENGINE. WHERE PRACTICAL, THE SUCTION HOSE SHOULD BE TIED TO SOME NEARBY STRUCTURE AND/OR BLOCKS SHOULD BE PLACED BENEATH THE SUCTION HOSE ADJACENT TO THE UNIT TO RELIEVE STRESS ON THE PUMP. (Page 2-2)**

**CAUTION**

**A STRONG DELIBERATE PULL IS REQUIRED TO PREVENT ENGINE KICK-BACK AND POSSIBLE STARTING IN THE REVERSE ROTATIONAL DIRECTION. IF THIS DOES OCCUR, IMMEDIATELY SHUT DOWN THE ENGINE. OPERATION IN THE REVERSE DIRECTION IS CHARACTERIZED BY THE EVIDENCE OF EXHAUST GASES COMING OUT OF THE INTAKE FILTER. REVERSE OPERATION DOES NOT ALLOW FULL POWER OPERATION, POSITIVE PRIMING, AND WILL CAUSE DAMAGE TO THE UNIT. (Page 2-4, page )**

**CAUTION**

**NEVER RUN THE PUMP AT HIGH SPEEDS, UNLESS IT IS DISCHARGING WATER. (Page 2-4)**

**CAUTION**

**NEVER RUN THE PUMP WITHOUT WATER ANY LONGER THAN THE SHORT TIME REQUIRED FOR PRIMING. (Page 2-4)**

**CAUTION**

**EXTENDED OPERATION WITHOUT PRIME MAY CAUSE SERIOUS DAMAGE TO THE PACKING GLAND, THE PUMP SHAFT, AND OTHER PUMP INTERNALS. (Page 2-5)**

**CAUTION**

**OVER-FUELING THE ENGINE WILL CAUSE DILUTION OF THE ENGINE OIL AND PREMATURE WEAR ON THE CYLINDER WALLS AND BEARINGS. (Page 2-5)**

**CAUTION**

**IN COLD WEATHER, IT IS IMPORTANT TO MAKE SURE THE TUBING LEADING FROM THE EXHAUST PRIMER TO THE PUMP CASING IS FREE FROM WATER TO PREVENT FREEZING. FREEZING OF THIS TUBING WILL RENDER THE EXHAUST PRIMER INOPERATIVE AND MAY DAMAGE TUBING AND FITTINGS. (Page 2-7)**

**CAUTION**

NEVER BREAK OR RESTRICT SUCTION OR ADMIT AIR TO SUCTION LINE WHILE ENGINE IS OPERATING WITH THROTTLE OPEN. THIS WILL RELEASE THE LOAD AND POSSIBLY ALLOW THE ENGINE TO OVER-SPEED. (Page 2-8)

**CAUTION**

P-100 (2BE10YDN) PUMPS HAVE TWO DIFFERENT ENGINES. IDENTIFY ENGINE BY PART NUMBER ON ENGINE LABEL PLATE. USE APPLICABLE ENGINE DATA FROM **CHAPTER 7** AND ENGINE APL WHEN ORDERING REPAIR PART FOR THE DIFFERENT ENGINE MODELS. (Page 6-5)

**CAUTION**

THIS COMPLETES THE DISASSEMBLY AND REASSEMBLY. BE SURE TO CHECK THAT ALL THE PARTS ARE REASSEMBLED CORRECTLY ACCORDING TO THE FOLLOWING PROCEDURES. (Page 6-26)

**CAUTION**

THE INTAKE/EXHAUST VALVE GUIDES ARE PROVIDED WITH A VALVE STEM SEAL. STEM SEALS CANNOT BE REUSED AND MUST BE REPLACED WITH NEW ONES (see **Figure 6-39**). (Page 6-28)

**CAUTION**

WHEN INSERTING THE INTAKE AND EXHAUST VALVE, APPLY LUBRICATING OIL TO VALVE STEM. (Page 6-28)

**CAUTION**

WHEN ASSEMBLING THE VALVE SPRING, PLACE THE IDENTIFICATION MARK (WHITE PAINTED) OF THE VALVE SPRING TOWARD THE CYLINDER HEAD. (Page 6-29)

**CAUTION**

**MOUNT THE METAL SO THAT THE OIL GROOVE FACES UP. (Page 6-38)**

**CAUTION**

**THE SINKAGE SHOULD BE 1 MM (0.0394 IN.) FROM THE THRUST SURFACE. (Page 6-38)**

**CAUTION**

**KEEP THE INTAKE AND EXHAUST TAPPETS SEPARATE DURING DISASSEMBLY OR REASSEMBLY. (Page 6-41)**

**CAUTION**

**THE ID MARKS THE PUMP IS ON THE PUMP MOUNTING FLANGE. NONE OF THESE FUEL INJECTION PUMPS IS INTERCHANGEABLE. THE FUEL INJECTION PUMP FOR DISCRETE ENGINE DIFFERS FROM THE GENERATOR IN THE DIRECTION OF THE FUEL INLET PIPE. (Page 6-45)**

**CAUTION**

**WHEN REPLACING FUEL INJECTION VALVE, BE SURE TO CHECK ENGINE MODEL AGAINST THE IDENTITY MARKS SHOWN ABOVE. ANY INJECTION VALVE IS LEAST IDENTIFIABLE IN APPEARANCE. (Page 6-49)**

**CAUTION**

**WHEN REMOVING THE FUEL INJECTION VALVE, WRAP IT IN CLOTH TO PROTECT THE NOZZLE TIP (INJECTION PORT). DO NOT PLACE THE NOZZLE TIP DIRECTLY ON THE GROUND. (Page 6-49)**

**CAUTION**

**MAKE SURE EACH CYLINDER IS IN THE T.D.C BEFORE ADJUSTING THE CLEARANCE. THIS WAY THE INTAKE/EXHAUST ROCKER**

**ARMS WILL NOT MOVE EVEN IF THE CRANKSHAFT IS TURNED CLOCKWISE OR COUNTERCLOCKWISE FROM THE TD MARK. (Page 6-56)**

**CAUTION**

**NEVER MIX DIFFERENT BRANDS OF LUBRICATING OIL. (Page 6-57)**

**CAUTION**

**ALWAYS ALLOW THE ENGINE TO COOL OFF BEFORE STOPPING. (Page 6-59)**

**CAUTION**

**AFTER THE ENGINE HAS BEEN USED, CLEAN THE ENGINE IMMEDIATELY WITH A CLOTH TO PREVENT CORROSION AND TO REMOVE SEDIMENT. (Page )**

**CAUTION**

**ONLY USE GENUINE DARLEY AND YANMAR PARTS. THE USE OF REPLACEMENT PARTS THAT ARE NOT OF EQUIVALENT QUALITY MAY DAMAGE THE ENGINE. (Page )**

**CAUTION**

**ONLY USE THE RECOMMENDED DIESEL FUEL OIL. USE OF NON-RECOMMENDED FUEL MAY CAUSE CLOGGING IN THE FUEL OIL STRAINER, FUEL INJECTION PUMP, AND FUEL INJECTION NOZZLE. (Page )**

**CAUTION**

**U.S. NAVY USER FUEL MUST BE F-76 OR JP-5, FILTERED CLEAR AND BRIGHT. (Page )**

**CAUTION**

**DO NOT FILL FUEL TANK BEYOND THE TOP OF THE RED PLUG INSIDE THE FUEL TANK STRAINER. (Page , page , page , page , page )**

**CAUTION**

**F-76 AND JP-5 VAPORS ARE COMBUSTIBLE. WHEN WORKING ON ANY PART OF FUEL SYSTEM, PROVIDE ADEQUATE VENTILATION AND AVOID HIGH HEAT AND OPEN FLAME. (Page )**

**CAUTION**

**AVOID PROLONGED CONTACT WITH, OR INHALATION OF, CLEANING SOLVENTS. AVOID USE NEAR HEAT OR OPEN FLAME AND PROVIDE ADEQUATE VENTILATION. (Page )**

**CAUTION**

**INSPECT AND FILL ENGINE OIL LEVEL ON A LEVEL SURFACE WITH ENGINE STOPPED. CHECKING OIL LEVEL ON A NON LEVEL SURFACE WILL RESULT IN A FALSE READING. OVERFILLING WITH OIL WILL RESULT IN EXCESSIVE OIL CONSUMPTION, HIGH OIL TEMPERATURES, POSSIBLE CRANKCASE EXPLOSION AND ENGINE DAMAGE. INSUFFICIENT OIL LEVELS WILL RESULT ENGINE SEIZURE. (Page )**

**CAUTION**

**INSPECT AND FILL ENGINE OIL LEVEL ON A LEVEL SURFACE WITH ENGINE STOPPED. CHECKING OR FILLING OIL LEVEL ON A NON LEVEL SURFACE WILL RESULT IN A FALSE READING. OVERFILLING WITH OIL WILL RESULT IN EXCESSIVE OIL CONSUMPTION, HIGH OIL TEMPERATURES, POSSIBLE CRANKCASE EXPLOSION AND ENGINE DAMAGE. INSUFFICIENT OIL LEVELS WILL RESULT ENGINE SEIZURE (see [Figure 4-3](#)). (Page )**

**CAUTION**

**WHEN CHECKING THE OIL LEVEL, MAKE SURE YOUR ENGINE IS SITTING LEVEL. IF IT IS TILTED, YOU MAY ADD EITHER TOO MUCH OR TOO LITTLE OIL. IF YOU OVERFILL, YOUR ENGINE WILL CONSUME TOO MUCH OIL AND THE OIL TEMPERATURE WILL BECOME DANGEROUSLY HIGH; IF YOU DO NOT ADD ENOUGH OIL, YOUR ENGINE COULD SEIZE UP. (Page )**



**CAUTION**

**DO NOT WASH THE AIR CLEANER ELEMENT WITH DETERGENT.**  
(Page )

**CAUTION**

**NEVER RUN THE ENGINE WITHOUT THE ELEMENT OR WITH A DEFECTIVE ELEMENT.** (Page )

**CAUTION**

**MANUAL TURNING OF THE SHAFT IS PERFORMED TO REDUCE THE COMPRESSION OF THE PUMP SHAFT PACKING. DO NOT OPERATE THE PUMP UNIT DRY. DO NOT START THE PUMP UNIT WHEN MANUALLY TURNING THE ENGINE/PUMP SHAFT. IMMEDIATELY SECURE THE ENGINE IF THE ENGINE STARTS WHEN PERFORMING THIS PROCEDURE IN ACCORDANCE WITH EMERGENCY STOP PROCEDURES.** (Page )

**CAUTION**

**PERSONNEL SHALL WEAR APPROVED HEARING PROTECTIVE DEVICES WHEN ENGINE IS OPERATING.** (Page )

**CAUTION**

**DO NOT ATTEMPT TO START OR OPERATE PUMP UNIT BEFORE READING AND THOROUGHLY UNDERSTANDING CHAPTER 2, OPERATION.** (Page )

**CAUTION**

**A HIGH SPOT AND/OR CLOSE RADIUS BEND IN SUCTION LINE MAY FORM AN AIR TRAP AND PREVENT COMPLETE PUMP PRIMING. ALWAYS ATTACH SUCTION HOSE TO PUMP PRIOR TO PLACING HOSE IN WATER.** (Page , page )

**CAUTION**

**FUEL MUST BE F-76 OR JP-5, FILTERED CLEAR AND BRIGHT. (Page , page )**

**CAUTION**

**INSPECT ENGINE OIL LEVEL ON A LEVEL SURFACE WITH ENGINE STOPPED. CHECKING OIL LEVEL ON A NON-LEVEL SURFACE WILL RESULT IN A FALSE READING. OVERFILLING WITH OIL WILL RESULT IN EXCESSIVE OIL CONSUMPTION, HIGH OIL TEMPERATURES, POSSIBLE CRANKCASE EXPLOSION AND ENGINE DAMAGE. INSUFFICIENT OIL LEVELS WILL RESULT ENGINE SEIZURE. (Page , page )**

**CAUTION**

**DO NOT CONTINUE TO OPERATE THE PUMP UNIT IF PRIMING CAN NOT BE ACHIEVED WITHIN TWO MINUTES. SHUTDOWN ENGINE AND TROUBLESHOOT FOR CAUSE OF FAILURE TO ACHIEVE PRIME. (Page , page )**

**CAUTION**

**DO NOT OPERATE PUMP UNIT CONTINUOUSLY WITHOUT DISCHARGING WATER. OPERATION OF THE PUMP WITH A CLOSED DISCHARGE VALVE WILL RESULT IN OVERHEATING OF AND DAMAGE TO THE PUMP. AT A MINIMUM, BLEED A SMALL AMOUNT OF WATER FROM A SECONDARY DISCHARGE HOSE WHEN THE PUMP IS OPERATING AND THE PRIMARY HOSE AND NOZZLE ARE SECURED. (Page )**

**CAUTION**

**OBSERVE EXHAUST SMOKE COLOR AFTER PRIMING HAS BEEN ACHIEVED AND PUMP IS DISCHARGING WATER. EXHAUST SMOKE COLOR SHOULD BECOME CLEAR OR LIGHT BLUISH AS THE ENGINE WARMS UP. IN HIGH LOAD SITUATIONS, THE CONTINUED APPEARANCE OF BLACK EXHAUST SMOKE AFTER THE ENGINE HAS WARMED UP INDICATES OVERFUELING OF THE ENGINE. OVERFUELING OF THE ENGINE WILL CAUSE FUEL DILUTION OF THE LUBE OIL AND ENGINE DAMAGE WITH CONTINUED OPERA-**

**TION. ADJUSTMENT OF THE THROTTLE TO REDUCE ENGINE LOAD IS REQUIRED IF EVIDENCE OF ENGINE OVERFUELING IS OBSERVED. (Page , page )**

**CAUTION**

**DO NOT OPERATE PUMP UNIT CONTINUOUSLY WITHOUT DISCHARGING WATER. OPERATION OF THE PUMP WITH A CLOSED DISCHARGE VALVE WILL RESULT IN OVERHEATING OF AND DAMAGE TO THE PUMP. WHEN OPERATING WITH AN EDUCTOR, RECIRCULATION OF WATER THROUGH THE EDUCTOR CHARGING LINE IS SUFFICIENT TO ENSURE FLOW IS MAINTAINED UNTIL WATER IS DISCHARGED FROM THE 1-1/2" HOSE AND NOZZLE. (Page )**

**CAUTION**

**AVOID PROLONGED CONTACT WITH, OR INHALATION OF, CLEANING SOLVENTS. AVOID USE NEAR HEAT OR OPEN FLAME AND PROVIDE ADEQUATE VENTILATION. (Page )**

**CAUTION**

**FUEL MUST BE F-76 OR JP-5, FILTERED CLEAR AND BRIGHT WITH NO MORE THAN 2 MILLIGRAMS PER LITER (MG/L) OF SOLIDS AND NO MORE THAN 5 PARTS PER MILLION (PPM) OF WATER. (Page )**



## CHAPTER 1

### GENERAL INFORMATION AND SAFETY PRECAUTIONS

#### 1-1. GENERAL INFORMATION.

In order to ensure safe working conditions, be sure to read the precaution sections for safe operation of the pump unit.

Pay special attention to statements preceded by the following words.

---

#### **WARNING**

---

**Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed.**

---

#### **CAUTION**

---

**Indicates a possibility of personal injury or equipment damage if instructions are not followed.**

#### **NOTE**

**Provides helpful information.**

#### 1-2. SAFETY PRECAUTIONS.

---

#### **WARNING**

---

**THE PUMP UNIT IS DESIGNED TO GIVE SAFE AND DEPENDABLE SERVICE PROVIDED THAT IT IS OPERATED ACCORDING TO INSTRUCTIONS. READ AND UNDERSTAND THE OPERATION MANUAL BEFORE OPERATING THE PUMP UNIT FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR EQUIPMENT DAMAGE.**

#### 1-3. PREVENTING FIRES.

---

#### **WARNING**

---

**UNLESS IT IS A DIRE EMERGENCY, NEVER ADD FUEL TO THE FUEL TANK WHILE THE ENGINE IS RUNNING. WHEN EMERGENCY**

*Warning-continued*

**Warning** - *precedes*

**REFUELING BECOMES NECESSARY, A SECOND PERSON SHALL STANDBY WITH AN APPROPRIATE FIRE EXTINGUISHER. WIPE AWAY ALL FUEL SPILLS WITH A CLEAN CLOTH. KEEP GASOLINE, KEROSENE, HATCHES AND OTHER EXPLOSIVES AND INFLAMMABLES AWAY FROM THE ENGINE, BECAUSE THE TEMPERATURE AROUND THE EXHAUST MUFFLER IS VERY HIGH DURING OPERATION.**

---

**WARNING**

---

**TO PREVENT FIRE HAZARDS AND TO PROVIDE ADEQUATE VENTILATION, KEEP THE PUMP UNIT AT LEAST THREE FEET (1 M) AWAY FROM BUILDINGS AND OTHER EQUIPMENT DURING OPERATION.**

---

**WARNING**

---

**OPERATE THE PUMP UNIT ON A LEVEL SURFACE AS FAR AS POSSIBLE. THE ALLOWABLE INCLINATION OF THE ENGINE FOR CONTINUOUS USE IS WITHIN 20 DEGREES. THERE MAY BE FUEL SPILLAGE IF THE ENGINE IS TILTED BEYOND THAT LIMIT.**

---

**WARNING**

---

**DO NOT PUT THE PUMP UNIT INDOORS WHILE THE ENGINE IS STILL HOT.**

#### **1-4. PREVENTING EXHAUST GAS INHALATION**

---

**WARNING**

---

**EXHAUST GAS CONTAINS POISONOUS CARBON MONOXIDE. NEVER USE THE PUMP UNIT IN POORLY VENTILATED LOCATIONS, SUCH AS INDOORS AND INSIDE TUNNELS. IF INDOOR OPERATION IS UNAVOIDABLE, PROVIDE PROPER VENTILATION AND USE AN APPROVED EXHAUST HOSE ROUTED TO WEATHER.**

**1-5. PREVENTING BURNS.**

---

**WARNING**

---

**NEVER TOUCH THE MUFFLER, MUFFLER COVER OR ENGINE BODY WHILE THE ENGINE IS RUNNING OR HOT.**

---

**WARNING**

---

**NEVER TOUCH THE HOT EXHAUST HOSE WHEN OPERATING THE PUMP UNIT WITHOUT USING FIREFIGHTER'S GLOVES. EXHAUST HOSE TEMPERATURES MAY CAUSE BURNS ON UNPROTECTED HANDS.**

**1-6. OTHER SAFETY TIPS.**

---

**WARNING**

---

**KNOW HOW TO STOP THE ENGINE QUICKLY AND UNDERSTAND HOW TO OPERATE ALL OF THE CONTROLS. NEVER PERMIT ANYONE TO OPERATE THE ENGINE WITHOUT PROPER INSTRUCTION.**

---

**WARNING**

---

**KEEP AWAY FROM ROTATING PARTS WHILE THE ENGINE IS RUNNING.**

---

**CAUTION**

---

**ONLY USE THE CORRECT TOOLS AND EQUIPMENT.**





## CHAPTER 2

### OPERATION

#### **WARNING**

**READ OPERATING INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO OPERATE THE PUMP UNIT!**

#### **2-1. LUBRICATION.**

Check engine lube oil for proper level prior to attempting to start the pump unit.

#### **CAUTION**

**WHEN CHECKING THE OIL LEVEL, MAKE SURE THAT THE PUMP UNIT IS SITTING LEVEL. IF IT IS TILTED, YOU MAY ADD EITHER TOO MUCH OR TOO LITTLE OIL. OVERFILLING THE RECOMMENDED OIL LEVEL MAY CAUSE THE ENGINE TO CONSUME TOO MUCH OIL AND THE OIL TEMPERATURE MAY BECOME DANGEROUSLY HIGH. OPERATION OF THE PUMP UNIT WITH THE OIL LEVEL BELOW THE RECOMMENDED LEVEL MAY CAUSE SEVERE DAMAGE TO THE ENGINE.**

To check the oil level, simply unscrew, wipe, and dip the dipstick into the oil pan (see [Figure 2-1](#)). Do not screw in the dipstick. Screwing the dipstick in will give a false reading indicating that the level is higher than the actual level present. For convenience, a dipstick is located on each side of the engine.

#### **CAUTION**

**NEVER CHECK THE ENGINE LUBE OIL LEVEL WHILE THE ENGINE IS RUNNING.**

#### **2-1.1 U.S. Navy Specific**

#### **NOTE**

PERIODIC GREASING OF SELECTED COMPONENTS IS PERFORMED IN ACCORDANCE WITH PLANNED MAINTENANCE SYSTEM (PMS) CHECKS; SEE CHAPTER 5.

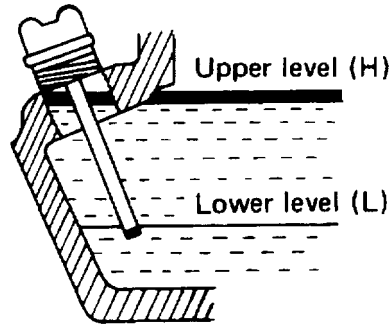


Figure 2-1 Checking Oil

## 2-2. PREPARATION FOR PRIMING.

- a. Check coupling gaskets and connect hose lines with couplings properly tightened.
- b. A strainer with openings not larger than 1/4" mesh must always be used on the end of suction line when pumping water from draft.

### **CAUTION**

**THE SUCTION HOSE MAY REQUIRE SUPPORT TO PREVENT EXCESSIVE WEIGHT FROM STRESSING THE PUMP CASING, INBOARD HEAD, OR ENGINE. WHERE PRACTICAL, THE SUCTION HOSE SHOULD BE TIED TO SOME NEARBY STRUCTURE AND/OR BLOCKS SHOULD BE PLACED BENEATH THE SUCTION HOSE ADJACENT TO THE UNIT TO RELIEVE STRESS ON THE PUMP.**

- c. Avoid air traps in suction hose if possible.

### **NOTE**

**BE CERTAIN THAT THE SUCTION HOSE (OR PIPE) IS ABSOLUTELY AIR TIGHT. NEITHER THE PUMP NOR THE PRIMER WILL LIFT WATER IF THE SUCTION SIDE OF THE PUMP HAS THE SLIGHTEST AIR LEAK.**

- d. Keep the suction intake strainer well above the bottom of the water source to prevent picking up soil and other foreign matter. If the strainer must lie on the bottom, a metal plate or pan should be laid under it.

## 2-2.1 U.S. NAVY SPECIFIC

### **NOTE**

**U.S. NAVY PUMP USERS UTILIZE AN APPROVED COMBINATION SUCTION STRAINER/FOOT VALVE. UNIQUE SHIPBOARD SCENARIOS AND NAVY DAMAGE CONTROL AND FIREFIGHTING DOCTRINE SUPERSEDE COMMERCIAL USER GUIDANCE PROVIDED IN THIS MANUAL.**

**NOTE**

WATER MAY BE DRAFTED FROM PONDS, LAKES, STREAMS, CISTERNS, TANKS, SEA WATER, AND/OR WELLS. WHATEVER THE SOURCE, THE STATIC LIFT MUST NOT EXCEED 22 FEET FROM THE CENTER OF THE PUMP TO THE SURFACE OF THE WATER. A LIFT NOT EXCEEDING 10 FEET IS RECOMMENDED. THE SOURCE OF SUPPLY SHOULD BE REASONABLY CLEAR AND FREE FROM FOREIGN MATTER.

- a. Submerge the suction intake sufficiently into the water to prevent sucking in air. A cover laid over the top of the strainer will allow the pump to operate with a minimum of submergence.
- b. Close drain valve and all other openings into pump casing.
- c. Do not start the engine until everything is ready for pumping, with hose couplings properly tightened. Pump discharge check valve may be partly open during priming at lifts less than 10 feet, and completely closed for lifts of 10 feet and more.

**2-3. STARTING AND PRIMING THE PUMP UNIT.**

---

**WARNING**

---

**DO NOT OPERATE THE PUMP UNIT IN CONFINED SPACES UNLESS THE EXHAUST HOSE IS CONNECTED TO CARRY THE TOXIC ENGINE EXHAUST GASES TO WEATHER.**

---

**WARNING**

---

**HEARING PROTECTION IS REQUIRED IN THE IMMEDIATE AREA OF THE PUMP UNIT WHILE IN OPERATION.**

- a. Set the fuel tank isolation valve located under the fuel tank to "O" (open) position.
- b. Set the engine throttle control to the "START" position.
- c. Open the primer line shut-off valve between the primer jet, and the pump suction. (Valve is open when knob is in line with the air passage.)
- d. Slowly pull on the recoil starter checking engine and pump for freedom of movement and priming the engine with lubricating oil. Depress the compression release lever ensuring that it remains depressed. The compression release lever will spring shut when the engine rotates during starting attempts (see Figure 2-2).
- e. Start the engine by pulling the recoil starter rope (see Figure 2-3).

**CAUTION**

**A STRONG DELIBERATE PULL IS REQUIRED TO PREVENT ENGINE KICK-BACK AND POSSIBLE STARTING IN THE REVERSE ROTATIONAL DIRECTION. IF THIS DOES OCCUR, IMMEDIATELY SHUT DOWN THE ENGINE. OPERATION IN THE REVERSE DIRECTION IS CHARACTERIZED BY THE EVIDENCE OF EXHAUST GASES COMING OUT OF THE INTAKE FILTER. REVERSE OPERATION DOES NOT ALLOW FULL POWER OPERATION, POSITIVE PRIMING, AND WILL CAUSE DAMAGE TO THE UNIT.**

- f. Once the engine is running, set the engine throttle control to the **"RUN"** position.

**CAUTION**

**NEVER RUN THE PUMP AT HIGH SPEEDS, UNLESS IT IS DISCHARGING WATER.**

**CAUTION**

**NEVER RUN THE PUMP WITHOUT WATER ANY LONGER THAN THE SHORT TIME REQUIRED FOR PRIMING.**

**NOTE**

START THE ENGINE AND RUN AT A FAST IDLE TO PRIME WITH LIFTS LESS THAN 10 FEET. START THE ENGINE AND RUN AT FULL THROTTLE TO PRIME WITH 10 TO 22 FOOT LIFTS.

- g. Shift the exhaust valve to the prime position blocking the main exhaust opening. The exhaust valve is in the prime position when the handle is horizontal.

**NOTE**

WHEN PRIMING ON HIGH LIFTS, OR WHEN PUMPING DIRTY WATER, IT MAY BE NECESSARY TO SEAT THE DISCHARGE STOP-CHECK VALVE BY TIGHTENING DOWN GENTLY WITH THE HANDWHEEL. UNSCREW THE HANDWHEEL WHEN WATER IS DISCHARGED THROUGH THE EXHAUST JET.

- h. When a steady stream of water appears at the discharge of the priming jet, close the primer line shut-off valve and return the engine exhaust valve to the normal position. Open the pump discharge valve.
- i. Repeat the priming operation if the pump fails to hold its prime. If the pump does not deliver water within two minutes, stop the engine and check for air leaks at suction connections and/or the pump packing gland, or failure of the priming jet to produce vacuum.

### **CAUTION**

---

**EXTENDED OPERATION WITHOUT PRIME MAY CAUSE SERIOUS DAMAGE TO THE PACKING GLAND, THE PUMP SHAFT, AND OTHER PUMP INTERNALS.**

- j. After priming the pump with water, start the pump and raise the discharge pressure to 50 psi. Tighten the packing screw using a 6" long 9/16" end wrench until drip rate is between 5 and 60 drops per minute - do not over-torque (24 in-lb torque). Continue operating the pump at 50 psi for 5 minutes to dissipate packing pressure against the shaft and permit cooling water to flow between the shaft and stuffing box hole. Make sure that water actually does come through before operating pump at any higher pressure. The normal drip rate may vary between 5 and 60 drops per minute.

### **NOTE**

**THE PACKING GLAND SCREW SHOULD BE KEPT SUFFICIENTLY TIGHT TO PREVENT EXCESSIVE LEAKAGE ONLY. SLIGHT LEAKAGE IS ALWAYS REQUIRED DURING OPERATION TO COOL THE PACKING AND PREVENT DAMAGE TO THE IMPELLER SHAFT.**

- k. Operate the pump for 10 minutes at the highest normal operating pressure flowing sufficient water to prevent overheating. Do not run the pump blocked tight. Lower discharge pressure to 50 psi. and repeat the packing screw tightening procedure outlined above.
- l. The pump may now be operated for any time period required within its rated capacity, however, the drip rate should be monitored more frequently during the first few hours, and adjusted if necessary to achieve a stable flow rate. Several more adjustments may be required. All diesel engines must be throttled back by the operator in high load situations. This must be done to prevent over-fueling the engine as is evident by black exhaust smoke. Careful readjustment of the throttle will not cause a decrease in pump performance. Throttle back until pump performance just begins to decrease.
- m. While the pump unit is running, occasionally monitor the pump discharge gage and fuel tank level. For periods of extended operation, refueling may be necessary. Extreme caution is required when refueling a hot or running engine. An additional crew member must standby with an appropriate fire extinguisher (such as a portable AFFF) in the event that fuel is inadvertently spilled on hot engine parts.

### **CAUTION**

---

**OVER-FUELING THE ENGINE WILL CAUSE DILUTION OF THE ENGINE OIL AND PREMATURE WEAR ON THE CYLINDER WALLS AND BEARINGS.**

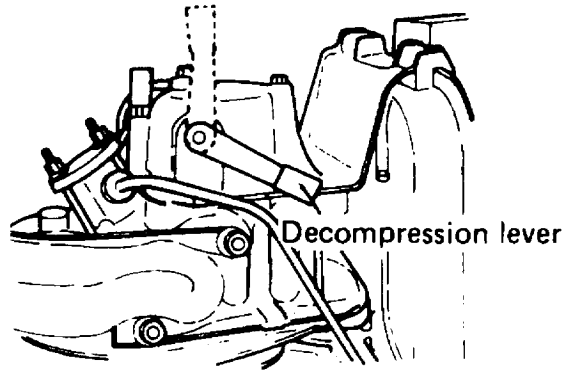


Figure 2-2 Starting and priming the pump unit

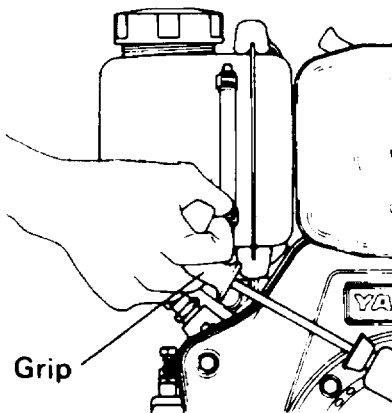


Figure 2-3 Starting the engine

#### 2-4. SHUTDOWN.

To stop the pump unit, reduce engine speed to an idle speed and allow the engine to cool down for two minutes. Return the engine throttle control to the "STOP" position. If engine continues to run, shut the fuel tank isolation valve.

After Operating the P-100 Pump, if the pump has been used to pump seawater, the seawater must be drained from the pump by opening the pump casing drain valve. The pump must be flushed with fresh water to prevent corrosion and salt crystals from forming on close toleranced pump internals. After flushing the pump, apply a spray silicone compound to pump internals while slowly pulling the starter rope and replace hose connection caps.

Drain water out of pump casing immediately. The drain valve is located at the lowest point in the pump casing.

Do not forget to close all drain cocks after draining all water. If forgotten, trouble in priming will follow on the next run.

Check lubrication after every run.

Periodically inspect and run pumps used for fire service to ensure that they will be ready in an emergency.

## 2-5. HIGH SUCTION LIFT OPERATION.

- a. Install Vita Motivator eductor with foot valve and strainer on the submerged end of the suction line.
- b. Suction line must slope down all the way from the pump to the water.
- c. Hand priming with the Vita Motivator eductor can be easily achieved by filling the hose through a gated Wye connected to the 1-1/2" feed line. By filling through the feed line, the check valve does not have to be held open as the water from the feed line will fill up the suction line and open the check valve.

## 2-6. COLD WEATHER OPERATION.

The first assurance against cold weather trouble is to keep fire apparatus stored in heated quarters.

When setting up for pumping, avoid unnecessary delays by thoroughly training pump operators. Be sure that primer lines are kept closed until ready for use. Have discharge lines ready so that pumping may be started as soon as it is primed.

Do not stop flow of water through the pump until ready to drain and return to the station.

Eliminate all water from pump casing and primer line between periods of operation.

### **CAUTION**

**IN COLD WEATHER, IT IS IMPORTANT TO MAKE SURE THE TUBING LEADING FROM THE EXHAUST PRIMER TO THE PUMP CASING IS FREE FROM WATER TO PREVENT FREEZING. FREEZING OF THIS TUBING WILL RENDER THE EXHAUST PRIMER INOPERATIVE AND MAY DAMAGE TUBING AND FITTINGS.**

To remove the water from the primer tubing:

- a. Restart the engine after disconnecting the suction line.
- b. Open primer line shut-off valve.
- c. Close engine exhaust valve tightly with lever at the side of exhaust primer.
- d. After five seconds, open exhaust valve.
- e. Shut off engine.

## 2-7. TESTING EQUIPMENT FOR PRACTICE.

### **NOTE**

**U.S. NAVY SPECIFIC: U.S. NAVY PUMP USERS ARE TRAINED TO RESPOND TO UNIQUE SHIPBOARD SCENARIOS. THE FOLLOWING IS INTENDED FOR COMMERCIAL USER GUIDANCE.**

Frequently, operators of a fire apparatus, who are not thoroughly familiar with its operation become confused under the stress of the emergency and neglect details that may cause trouble or delay in getting the equipment

into operation. We urge that practice tests be conducted repeatedly until operators are thoroughly trained. More than one individual in the department should be a competent operator.

Practice should include pumping from low lifts, high lifts with short and long suction lines, with suction line elevated to form an air trap, from hydrants, and at large and small capacities.

### **CAUTION**

**NEVER BREAK OR RESTRICT SUCTION OR ADMIT AIR TO SUCTION LINE WHILE ENGINE IS OPERATING WITH THROTTLE OPEN. THIS WILL RELEASE THE LOAD AND POSSIBLY ALLOW THE ENGINE TO OVER-SPEED.**

It is a good idea to note the effects of air leaks in hose, insufficient submergence and restriction of suction line. (Suction lines can be restricted by placing a can or other strong closure around the suction strainer.)



## CHAPTER 3

### FUNCTIONAL DESCRIPTION

#### 3-1. P-100 PUMP UNIT.

The P-100 pump unit is a commercial diesel driven portable pump designed for firefighting, dewatering, and many utility functions. The design features of the pump unit are described in the following paragraphs. The pump unit consists of the engine, centrifugal pump, exhaust primer, discharge valve, recoil starter, attached 1.45 gallon fuel tank, and compound pressure gage.

The pump unit measures 21"W X 23.5"L X 24.38"H. The wet weight of the pump unit is 164 pounds which includes 1.45 gallons of fuel that will allow 2.75 hours of operation. The pump is designed to provide 100 GPM at 83 PSI while lifting 20 feet. In high lift operations, the pump unit will deliver 68 GPM at 45 PSI while lifting 39 feet.

#### 3-1.1 ENGINE.

##### NOTE

YANMAR ENGINE MODEL L100AE-D WAS SUPPLIED PRIOR TO JANUARY 2000. YANMAR ENGINE MODEL L100EE-D IS SUPPLIED AFTER JANUARY 2000.

The Yanmar L100AE and L100EE engines are air cooled, single cylinder, four cycle diesel engine rated at 10 horsepower. Ignition is achieved by direct injection of fuel and compression is initially aided by a compression release lever to help overcome the 19.3 compression ratio. The engine is started by a recoil type starter. The engine's single cylinder has a displacement of 0.406 liters(24.78 cubic inches) which corresponds to the stroke X bore of 1-86 X 70 mm (3.386 X 2.756 in.).

The fuel injection pump is a Bosch type Yanmar PFE-M type, timed at 13 plus or minus 1 bTDC. It supplies a Yanmar YDLLA-P type fuel injection nozzle which delivers fuel at an injection pressure of 19.6 Mpa(200 kgf/square cm). The fuel oil filter is a paper element type built into the 5.5 liter(1.45 gallon) attached fuel tank.

The engine utilizes forced lubrication via trochoid pump and splash lubrication for valve rocker arm chamber. The lubricating oil filter is a resin, 60 mesh type. The engine lubricating oil capacity is 1.65 liters (0.44 gallons). The recommended oil for commercial use is SAE 10W30, API grade CC or higher for ambient temperatures less than 85 degrees F. The oil specified for Navy use is MIL-L-2104, equivalent to SAE 15W40.

The air cleaner element is a dry paper element type. The engine is cooled by forced air generated by a fly-wheel fan.

Speed control is accomplished by an all speed type mechanical governor.

The engine dimensions, length, width, height, is 417 X 470 X 494 mm (16.417 X 18.504 x 19.449 inches). The dry weight of the engine is 48.5 kg (106.9 lb).

#### 3-1.2 PUMP.

The Darley 2BE pump is a single suction, single stage centrifugal pump complete with a compound pressure gage, drain valve, and primer connection. The impeller is a closed design and the shaft is sealed by a unique pelletized packing gland. The shaft seal utilizes injection plastallic packing with a stuffing box. The suction and discharge connections have male threads which receive 3 inch and 2-1/2 inch hoses, respectively.

The pump casing is fabricated from a hard coat anodized aluminum alloy which is light weight and corrosion resistant.

The impeller is dynamically balanced and is of a bronze alloy construction. The wearing rings are a bronze labyrinth type.

### **3-1.3 EXHAUST PRIMER.**

The engine exhaust silencer is constructed to incorporate a jet type ejector and receive an insulated exhaust hose. When the primer is operated, the main exhaust port is blocked by the cylinder valve forcing the exhaust flow through the priming jet. The vacuum developed by the exhaust jet evacuates the air from the pump casing and suction hose. Because of the vacuum developed, atmospheric pressure forces water up through the suction hose and into the pump casing.

The exhaust hose is a dry 4.5" insulated hose which is available in 10' sections. The hose weighs only 1.7 pounds per linear foot and provides adequate protection for safe handling with firefighter's gloves during and after operation. The function of the exhaust hose is to safely route harmful exhaust gases to weather when indoor operation becomes necessary.

### **3-1.4 FUEL TANK.**

The 1.45 gallon capacity fuel tank is mounted to the engine. The tank consists of the tank, fuel filter, isolation valve, injection valve, level sight tube, and a fuel tank cap.

## CHAPTER 4

### TROUBLESHOOTING

#### 4-1. INTRODUCTION.

The following are some basic points to check when problems are encountered during starting and priming evolutions.

When the engine will not start:

- (1) Is there enough fuel? Is it the correct type of fuel?
- (2) Is the fuel cock at the "OPEN" position?
- (3) Is diesel fuel reaching the fuel injection pump or nozzle?
- (4) Is the speed control lever in the "START" position?
- (5) Is the lube oil level correct?
- (6) Is the fuel injection nozzle working properly?
- (7) Is the recoil starter pulled sufficiently quick and firm?

#### 4-2.

##### CHECK LIST FOR DARLEY CHAMPION FIRE PUMP PRIMING FAILURES.

1. Problem    Engine speed too low.  
Solution    When priming, run engine at high RPM.
2. Problem    Air leak through packing (or excessive water leakage when primed).  
Solution    Tighten packing while pumping at 50 psi by tightening packing screw. Adjust packing to 5 to 60 drops per minute. Do not allow packing to be drip free -- lubrication of the pump packing is necessary to prevent damage to the shaft. See Section [A.7](#), Injection Type Stuffing Box Adjustment, for complete instructions.
3. Problem    Suction hose.  
Solution    Make sure that the strainer at the end of the suction is fully emerged in the water, and free of debris. Air leaks through the suction hose gasket are the most common reason for failure to prime. Replace gasket if necessary.
4. Problem    Pump drain is open.  
Solution    Check pump drain to make sure that it is closed when priming.
5. Problem    Primer line is closed.  
Solution    Open primer line valve located near suction inlet and close once pump is primed.

#### 4-3. TROUBLESHOOTING GUIDE.

The following troubleshooting guide ([Table 4-1](#)) provides a more detailed breakdown of possible problems that may be encountered.

**IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT CHIPPEWA FALLS,  
WI. AT 800-634-7812 or 715-726-2650**

**Table 4-1. TROUBLESHOOTING GUIDE**

<b>PROBLEM</b>	<b>CAUSES</b>	<b>SUGGESTED CORRECTION</b>
PUMP FAILS TO PRIME OR LOSES PRIME	AIR LEAKS	CLEAN AND TIGHTEN ALL SUCTION CONNECTIONS. CHECK CONDITION OF HOSES AND HOSE GASKETS. CLOSE ALL PUMP DRAINS. CHECK PACKING GLAND FOR PROPER ADJUSTMENT. RUN DRY VACUUM TEST AS FOLLOWS:
		A) CONNECT SUCTION HOSE TO PUMP AND CAP END.
		B) DRAIN PUMP. CLOSE ALL DISCHARGE AND DRAINS.
		C) ENGAGE PRIMER AND DRAW A VACUUM, PREFER 20-22". SHUT OFF PRIMER.
		D) IF VACUUM DROPS MORE THAN 10" HG. IN 10 MINUTES, EXCESSIVE LEAKAGE IS PRESENT. WITH ENGINE SHUT OFF, AIR LEAKS ARE SOMETIMES AUDIBLE.
	DISCHARGE CHECK VALVE LEAKS.	REMOVE DISCHARGE CHECK VALVES AND REPAIR OR REPLACE.
(U.S. NAVY USE ONLY)	FOOT VALVE DAMAGED OR DEFECTIVE.	LEAKING FOOT VALVE PREVENTS MAINTAINING PRIME. REPLACE FOOT VALVE GASKETS OR REPLACE FOOT VALVE.
PUMP FAILS TO PRIME OR LOSES PRIME CONTINUOUSLY.	SUCTION WHIRLPOOL.	PUMPING LARGE VOLUMES WITH SUCTION HOSE TOO SHALLOW IN WATER SUPPLY CAN CAUSE WHIRLPOOLS, ALLOWING AIR TO BE DRAWN INTO PUMP, LOSING PRIME. PLACE SUCTION HOSE DEEPER, OR LESSEN VOLUME BEING PUMPED.
	HIGH POINT IN SUCTION LINE.	LOWER SUCTION HOSE BELOW PUMP SUCTION. IF NOT POSSIBLE, REPRIMING SEVERAL TIMES MAY BE NECESSARY TO REMOVE AIR LOCK.
	TOO HIGH OF A SUCTION LIFT.	SOMETIMES TOO HIGH OF A LIFT IS NOT OBTAINABLE EXCEPT AT LOW ALTITUDES WITH THE BEST OF EQUIPMENT. TRY TO KEEP THE LIFT AS LOW AS POSSIBLE.
CAPACITY OF PUMP LOW.	SUCTION HOSE TOO SMALL.	USE THE PROPER SIZE SUCTION HOSE FOR THE RATING OF THE PUMP.
	DEFECTIVE SUCTION HOSE.	SUCTION HOSE LINER MAY BE COLLAPSING, RESTRICTING FLOW TO PUMP. TRY DRAFTING WITH A DIFFERENT SECTION OF SUCTION HOSE.
	PLUGGED SUCTION STRAINER OR SCREEN.	CLEAN DEBRIS OUT OF STRAINER AND SCREEN. SET UP SUCTION WITH FLOATING STRAINER TO AVOID DEBRIS ON BOTTOM OF DRAFTING WATER SUPPLY.
	WORN IMPELLERS AND SEAL RINGS.	RE MACHINE OR REPLACE WORN IMPELLERS AND SEAL RINGS TO MEET W. S. DARLEY SPECIFICATIONS.
PRESSURE OUTPUT OF PUMP IS LOW.	ABOVE CAUSES OF LOW CAPACITY.	CHECK ALL OF THE ABOVE CAUSES OF LOW CAPACITY AS THEY CAN ALSO AFFECT PUMP PRESSURE.

**Table 4-1.** TROUBLESHOOTING GUIDE - Continued

PROBLEM	CAUSES	SUGGESTED CORRECTION
	TOO MUCH CAPACITY.	CAPACITY AND PRESSURE ARE DIRECTLY PROPORTIONAL. IF TRYING TO PUMP A LARGE CAPACITY, PRESSURE WILL BE LIMITED. ALSO INCREASING PUMP PRESSURE DOES NOT MEAN A VOLUME INCREASE IN WATER PUMPED.
PACKING LEAKS.	IMPROPERLY ADJUSTED PACKING.	SEE STUFFING BOX ADJUSTMENT SECTION

## CHAPTER 5

### SCHEDULED MAINTENANCE

#### 5-1. PERIODIC CHECKS AND MAINTENANCE.

##### NOTE

U.S. NAVY USER    REFER TO SHIPBOARD PLANNED MAINTENANCE SYSTEM (PMS) AND MAINTENANCE INDEX PAGE (MIP) 6641/019 FOR MOST CURRENT RECOMMENDATIONS FOR PMS PROCEDURES AND PERIODICITY. VARIATION IN PROCEDURES AND PERIODICITY HAVE RESULTED DUE TO UNIQUE SHIPBOARD OPERATING REQUIREMENTS.

##### NOTE

COMMERCIAL USER    REFER TO [APPENDIX A](#).





## CHAPTER 6

### CORRECTIVE MAINTENANCE

#### SOME CARE AND HANDLING INSTRUCTIONS.

#### NOTE

Modifications have been made to the pump. Earlier versions of the pump refer to Figure 7-1. Figure 7-12 refers to the modified P100 pump and shows a stiffening bracket between the discharge head.

1. Avoid unnecessary force and rough handling of parts during disassembly and reassembly.
2. Clean parts thoroughly and maintain free from abrasive foreign matter.
3. Keep bearings in original containers until ready to install.
4. Work with clean tools in clean surroundings during reassembly.
5. Do not bump or abrade machined surfaces, giving special care to wearing surfaces, shaft shoulders, gear and impeller hub faces, etc.
6. Use an arbor press for forcing press fits whenever possible. If necessary to use a hammer, use one having soft plastic heads.
7. Use suitable machined and fitted sleeves or bars for forcing or pressing part having press fits.
8. When forcing or pressing parts onto a tight fitting shaft, the part must be started square with the shaft and forced on squarely all the way.
9. Clean and oil parts having press fits to prevent galling.
10. Keep loose parts marked or otherwise identified to avoid errors in assembly.
11. Do not use this pump unit for hose testing.

**IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT CHIPPEWA FALLS, WI. AT 800-634-7812 or 715-726-2650**

#### 6-1. PUMP END DISASSEMBLY FOR OVERHAUL.

(Refer to Figure 7-1 or 7-12)

#### NOTE

Part identification numbers shown are from Figure 7-12. Use appropriate parts from Figure 7-1, when applicable, for pump models that do not have upgrade installed.

**NOTE**

Modifications have been made to the pump. Earlier versions of the pump refer to Figure 7-1. Figure 7-12 refers to the modified P100 pump and shows a stiffening bracket between the discharge head.

1. Disconnect primer hose (2) at the primer shut off valve (3).
2. Remove four 3/8" NC nuts (14), and remove the discharge head assembly and gasket (59) from pump casing (8).
3. Remove eight 3/8" NC nuts (14). Remove pump casing (8) from inboard head (24). Discard casing gasket (22).
4. If necessary to replace, remove seal ring (16) from pump casing (8).
5. Remove stainless steel cotter key (17), impeller nut (18), and impeller washer (19) from impeller shaft (27).

**NOTE**

Modifications have been made to the pump. Earlier versions of the pump refer to Figure 7-1. Figure 7-12 refers to the modified P100 pump and shows a stiffening bracket between the discharge head.

6. To remove impeller (20) from impeller shaft (27), use two flat bars or large screwdrivers on opposite sides of impeller. Bear against impeller where vanes provide support.
7. Loosen packing gland nut (56).
8. Remove four M8 x 1.25 x 25mm hex head cap screws (25) and slide the inboard head (24) away from the engine (33-1) and off the impeller shaft (27). Keep the inboard head (24) square with the engine (33-1) to avoid damaging parts.

**NOTE**

Modifications have been made to the pump. Earlier versions of the pump refer to Figure 7-1. Figure 7-12 refers to the modified P100 pump and shows a stiffening bracket between the discharge head.

9. If necessary to replace, remove stationary seal ring (16) from inboard head (24).
10. If necessary to replace, remove impeller shaft (27) from the engine (33-1) by driving the 3/16" spring pin (28) out of the impeller shaft and the engine shaft. Use a propane torch to heat the impeller shaft (27) uniformly to soften the Loctite 243 Threadlocker Compound. Pull the impeller shaft (27) off the engine.
11. If impeller shaft (27) is removed, the oil seal (29) must be replaced. The oil seal is installed with Loctite 380 (Black Max) adhesive. Care must be taken not to damage engine bore when removing this oil seal.

#### 6.1.1 Parts Inspection and Measurement.

1. Clean all parts and examine carefully for wear or deterioration. Replace any questionable parts.
2. Measure the impeller seal rings and seal ring for wear. Use the following table for comparison.

Impeller Seal Ring O.D.	3.304" - 3.303"
-------------------------	-----------------

- Continued

Seal Ring I.D.	3.315" - 3.314"
Clearance - original	0.010" - 0.012"

3. If clearance exceeds 0.025" on diameter, replace impeller and stationary seal rings.
4. The impeller shaft diameter at the packing area is 1.244 to 1.245", and the stuffing box bore diameter is 1.2500 to 1.2510" original, 1.2570" max. allowed. If shaft clearance exceeds 0.013", or if the pump cannot hold packing, either the impeller shaft, or the stuffing box, or both should be replaced depending on which part is out of tolerance.
5. The original impeller shaft diameter under the impeller is 0.8740 to 0.8745". The original impeller bore is 0.8745 to 0.8750" providing 0.0000 to 0.0010" clearance. The parts are still serviceable up to 0.0015" clearance.

## 6-2. RE-ASSEMBLY OF PUMP END.

(Refer to Figure 7-1 or 7-12).

### NOTE

APPLY LOCTITE 243 THREADLOCKER TO ALL PUMP RELATED THREADED FASTENERS.

### NOTE

Part identification numbers shown are from Figure 7-12. Use appropriate parts from Figure 7-1, when applicable, for pump models that do not have upgrade installed.

### NOTE

Modifications have been made to the pump. Earlier versions of the pump refer to Figure 7-1. Figure 7-12 refers to the modified P100 pump and shows a stiffening bracket between the discharge head.

### 6-2.1 Original Impeller Shaft Installation

1. To install original impeller shaft (27), slide impeller shaft onto engine shaft to check 3/16" pin holes for alignment. If holes do not line up, rotate impeller shaft 180 degrees. Apply a coating of Loctite 243 Threadlocker to engine shaft, and slide impeller shaft onto engine shaft. Align drive pin holes in impeller shaft with drive pin hole in engine shaft. Tap a 3/16" x 1-1/2" STAINLESS STEEL spring pin (28) into impeller shaft and engine shaft.
2. Clean the oil seal bore to remove any foreign matter. Clean bore with isopropyl alcohol or a suitable solvent.
3. Apply a light coating of grease to impeller shaft under the oil seal area.
4. Slide oil seal (29) into engine bore. Clean O.D. of oil seal with isopropyl alcohol or a suitable solvent.

5. Apply a coating of Loctite 380 (Black Max) to O.D. of oil seal. The concave side of the seal must face away from the engine. Pulling the starter rope to rotate the shaft will help apply the Loctite 380 (Black Max)
6. Press the oil seal (29) into the engine bore. The oil seal will extend out of the cavity 1/8 inch.

**NOTE**

**WIPE OFF ANY EXCESS LOCTITE 380 (BLACK MAX), USE CARE NOT TO GET ANY ONTO OIL SEAL LIP.**

7. Fill the spring pin (28) with clear silicone to seal it closed.

#### 6-2.2 Replacement Impeller Shaft Installation

1. Slide impeller shaft (27) onto engine shaft.
2. Align the pre-drilled 3/16 inch hole in the impeller shaft with the hole in the engine shaft. Use a 3/16 inch drill to drill through the impeller shaft. Remove impeller shaft and remove all burs from both shafts.
3. Apply a coating of Loctite 243 Threadlocker to engine shaft, and slide impeller shaft (27) onto engine shaft. Align drive pin hole in the impeller shaft with the drive pin hole in the engine shaft. Tap a 3/16" x 1-1/2" STAINLESS STEEL spring pin (28) through impeller shaft and engine shaft.
4. Clean the oil seal bore to remove any foreign matter. Clean bore with isopropyl alcohol or a suitable solvent.
5. Apply a light coating of grease to impeller shaft under the oil seal area.
6. Slide oil seal (29) onto impeller shaft (27). Clean O.D. of oil seal with isopropyl alcohol or a suitable solvent.
7. Apply a coating of Loctite 380 (Black Max) to O.D. of oil seal. The concave side of the seal must face away from the engine. Pulling the starter rope to rotate the shaft will help apply the Loctite 380 (Black Max)
8. Press the oil seal (29) into the engine bore. The oil seal will extend out of the cavity 1/8 inch.

**NOTE**

**WIPE OFF ANY EXCESS LOCTITE 380 (BLACK MAX), USE CARE NOT TO GET ANY ONTO OIL SEAL LIP.**

9. Fill the spring pin (28) with clear silicone to seal it closed.

#### 6-2.3 Reassembly of Pump End

1. Apply Loctite 609 to the outside diameter of stationary seal ring (16). Press seal ring into inboard head (24) until seated.

**NOTE**

**WIPE OFF ANY EXCESS LOCTITE 609.**

2. Slide inboard head (24) assembly over impeller shaft (27) and engage with pilot on engine. Attach to engine with four M8 x 1.25 x 25mm hex head cap screws (25) . Torque to 13 ft-lbs.

3. Apply a coating of oil to impeller shaft (27). Place impeller key (21) in impeller shaft keyway. Align keyslot in impeller (20) with impeller key, and press impeller onto impeller shaft until impeller is tight against the shaft shoulder.
4. Place impeller washer (19) onto impeller shaft (27).
5. Clean and dry shaft threads and impeller nut (18), removing dirt, grease, and oil. (Loctite Klean N' Prime, Part No. 2556, can be used to clean parts and shorten Loctite cure time.)
6. Apply Loctite 243 Threadlocker to shaft threads and nut threads.
7. Tighten impeller nut (18) until it contacts impeller washer (19), then turn to the next cotter key hole.
8. Install a 3/32" x 3/4" stainless steel cotter key (17) into impeller shaft cotter key hole.
9. Apply Loctite 609 to the outside diameter of seal ring (16) Press seal ring into pump casing (8) until seated.

#### NOTE

WIPE OFF ANY EXCESS LOCTITE 609.

10. Place casing gasket (22) into position on inboard head (24).
11. Slide pump casing (8) into position on inboard head (24) Attach to inboard head with eight 3/8" NC nuts (14). Torque to 23 ft-lbs.
12. Attach discharge head assembly and gasket to pump casing (8) with four 3/8" NC nuts (14). Torque to 23 ft-lbs.
13. Connect primer hose (2) at primer shut off valve (3).

#### 6.2.4 Discharge head maintenance [\(Figure 7-1\)](#) or [\(Figure 7-12\)](#)

1. The discharge head assembly requires a minimal amount of maintenance. If some leakage occurs around the valve stem (71) and the gland nut (79), tighten the gland nut until it stops leaking. If leaking does not stop, the valve needs to be repacked.
2. Seized or damaged discharged head assembly requires replacement with upgraded discharge valve assembly (a # given by Pump company).

### 6-3. ENGINE DISASSEMBLY PROCEDURES.

#### CAUTION

**P-100 (2BE10YDN) PUMPS HAVE TWO DIFFERENT ENGINES. IDENTIFY ENGINE BY PART NUMBER ON ENGINE LABEL PLATE. USE APPLICABLE ENGINE DATA FROM CHAPTER 7 AND ENGINE APL WHEN ORDERING REPAIR PART FOR THE DIFFERENT ENGINE MODELS.**

**NOTE**

YANMAR ENGINE MODEL L100AE-D WAS SUPPLIED PRIOR TO JANUARY 2000. YANMAR ENGINE MODEL L100EE-D IS SUPPLIED AFTER JANUARY 2000.

**NOTE**

MODIFICATIONS HAVE BEEN MADE TO THE P-100 PUMP. EARLIER VERSIONS OF THE PUMP REFER TO FIGURE 7-1. FIGURE 7-12 REFERS TO THE MODIFIED P100 PUMP. FIGURE 7-12 SHOWS A STIFFENING BRACKET BETWEEN THE DISCHARGE HEAD

### 6-3.1 Basic Procedures

- 1) Gather the required tools, jigs and meters.
- 2) Have a notebook, etc. ready for recording service information.
- 3) Fill containers with cleaning solution for cleaning parts.
- 4) Prepare a special place for parts and containers.
- 5) Drain old lubricating oil from engine.
- 6) Arrange disassembled parts.
- 7) Keep all bolts and nuts with their relative parts to make sure they are not reassembled incorrectly. Determine exactly what the problem is before disassembly. Never remove unnecessary parts.
- 8) Remove pump from engine.

### 6-3.2 Fuel Tank

**(Refer to Figure 7-9 or Figure 7-20)**

- 1) Drain fuel tank.
- 2) Disconnect the fuel return line from the fuel tank.
- 3) Remove the fuel supply line clamp and hose from the injection pump.
- 4) Remove the fuel tank stay (upper part).
- 5) Remove the fuel tank (see Figure 6-1).

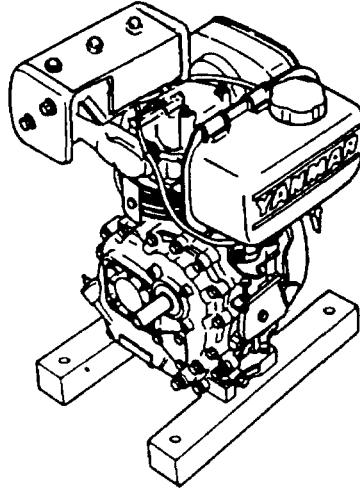


Figure 6-1 Removing the fuel tank

### 6-3.3 Exhaust Silencer (Muffler)

(Refer to Figure 7-1 or 7-12)

- 1) Remove the flange nuts.
- 2) Remove the stay bolt (see Figure 6-2).

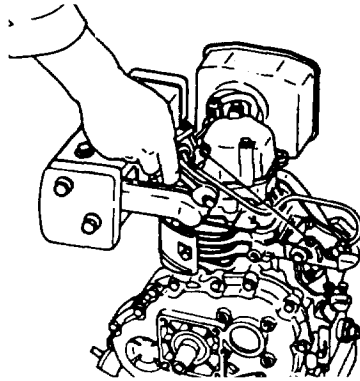


Figure 6-2 Removing the muffler

### 6-3.4 Air Cleaner

(Refer to Figure 7-4 or 7-15)

- 1) Remove the air cleaner cover.
- 2) Pull out the filter element.
- 3) Remove the cleaner case (see Figure 6-3).

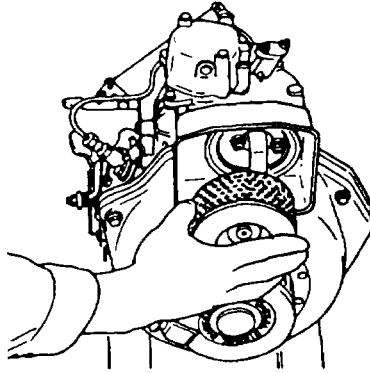


Figure 6-3 Removing the air cleaner

#### 6-3.5 Recoil Starter

**(Refer to Figure 7-7 or 7-18)**

Remove only when repairs are required. Disassembling the recoil starter is addressed in a separate section.

#### 6-3.6 Cooling Fan Case

**(Refer to Figure 7-7 or 7-18)**

Remove the cooling fan case.

#### 6-3.7 Starter Pulley

**(Refer to Figure 7-7 or 7-18)**

Remove flywheel nut and remove the starter pulley (see Figure 6-4).

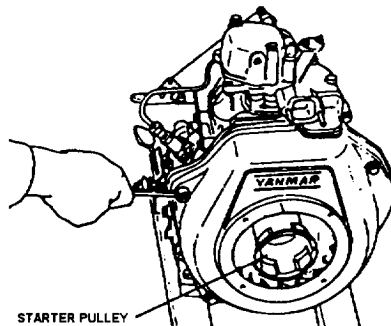


Figure 6-4 Removing the Starter Pulley

#### 6-3.8 Air Intake Bend

**(Refer to Figure 7-4 or 7-15)**

Remove the air intake bend (see Figure 6-5).



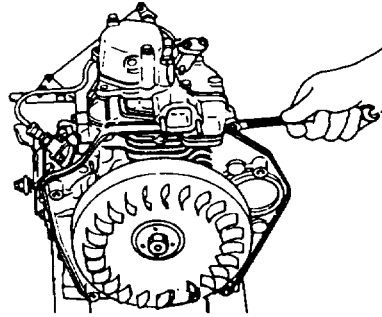


Figure 6-5 Removing the air Intake bend

### 6-3.9 Valve Rocker Arm Cover

**(Refer to Figure 7-3 or 7-14)**

Remove the valve rocker arm cover.

Remove the valve caps.

### 6-3.10 Valve Rocker Arm Assembly

**(Refer to Figure 7-3 or 7-14)**

Remove the valve rocker arms and support (see Figure 6-6).

Remove valve caps.

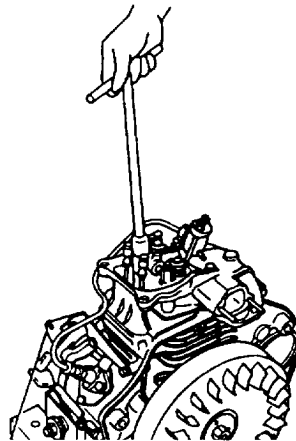


Figure 6-6 Removing the valve rocker arms

### 6-3.11 Push Rods

**(Refer to Figure 7-5 or 7-16)**

Pull out the push rods.

### 6-3.12 Fuel Injection Valve Assembly

**(Refer to Figure 7-8 or 7-19 and Figure 7-9 or 7-20)**

1) Remove the fuel injection pipe.

- 2) Remove the injection valve retainer.
- 3) Remove the fuel return hose.
- 4) Remove the fuel injection valve assembly.
- 5) Remove insulator using a long 8mm or 9mm bolt.
- 6) Air hose 30-50 lbs. through injector adaptor to check valve leaks (see Figure 6-7).

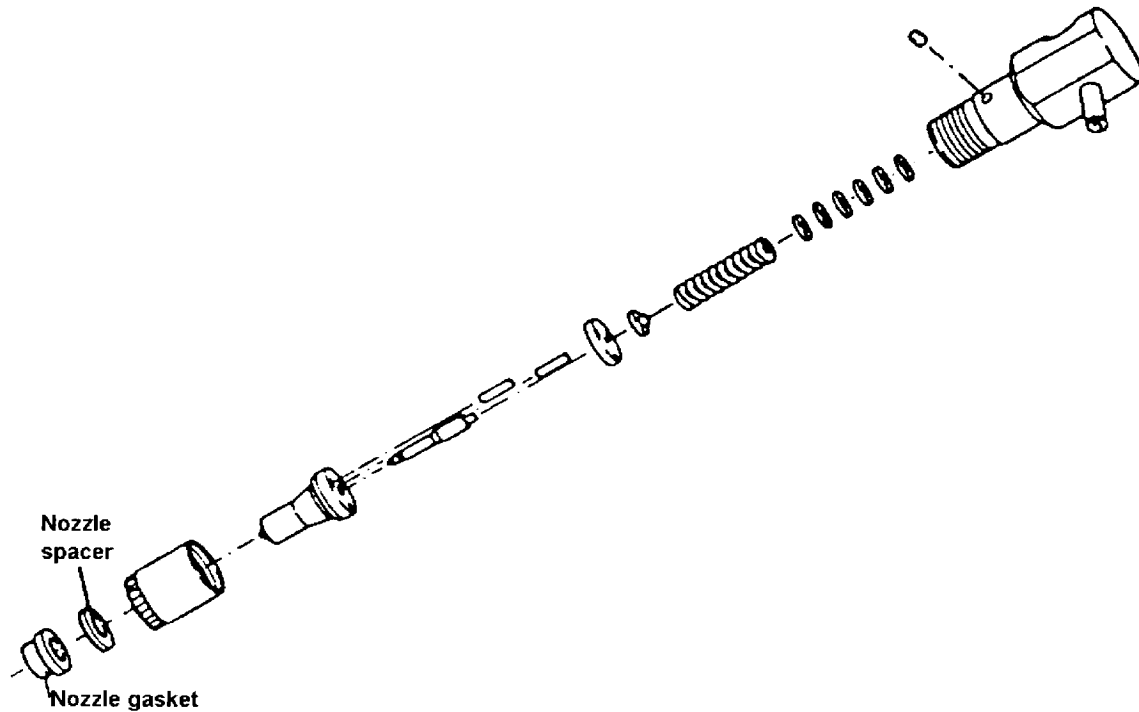


Figure 6-7 Fuel injection valve disassembled

### 6-3.13 Cylinder Head

(Refer to Figure 7-3 or 7-14)

- 1) Remove the cylinder head (see Figure 6-8).  
Keep the combustion surface faced up.

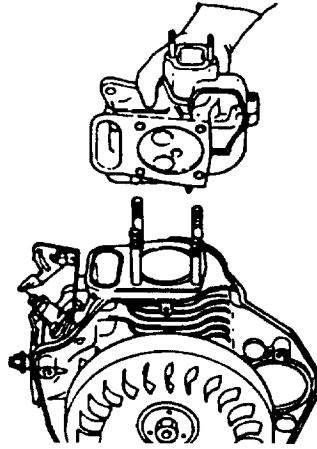


Figure 6-8 Removing the cylinder head

### 6-3.14 Fuel Injection Pump Assembly Removal

(Refer to Figure 7-8 or 7-19)

- 1) Remove the fuel injection pump assembly (see Figure 6-9).

Make sure to retain shims under injection pump assembly. Measure and record shims used. Shims affect engine timing and can be adjusted at reassembly.

Check position of rack. Adjust throttle lever to set rack in middle position.

Pull out the injection pump tappet.

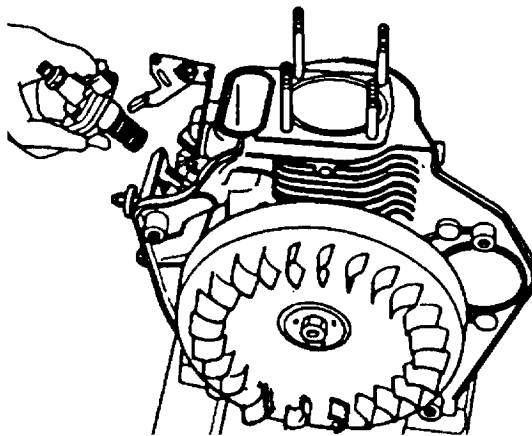


Figure 6-9 Removing the fuel pump

### 6-3.15 Crankcase Cover

(Refer to Figure 7-2 or 7-13)

Step 1) should only be done to inspect the lube oil pump.

- 1) Remove the oil pump cover.
- 2) Remove the crankcase cover (see Figure 6-10).

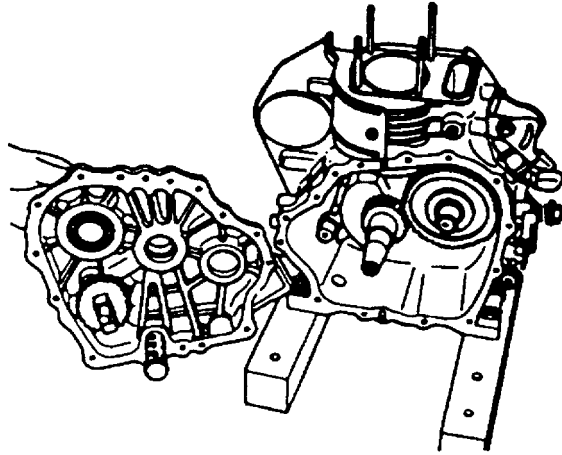


Figure 6-10 Removing the crankcase cover

#### 6-3.16 Camshaft

(Refer to Figure 7-5 or 7-16)

Pull out the camshaft (see Figure 6-11).

Check the timing mark.

Keep exhaust and intake tappets separate.

They may fall down when pulling out the camshaft and may be inadvertently switched.

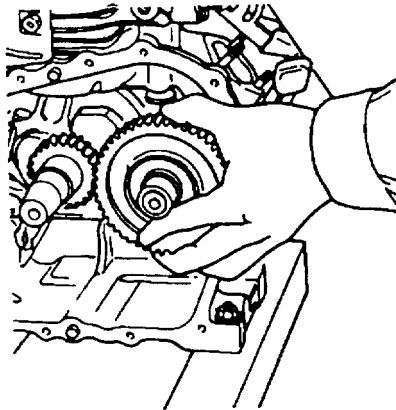


Figure 6-11 Removing the camshaft

#### 6-3.17 Balancer Shaft

(Refer to Figure 7-5 or 7-16)

Pull out the balancer shaft (see Figure 6-12).

Check marks.

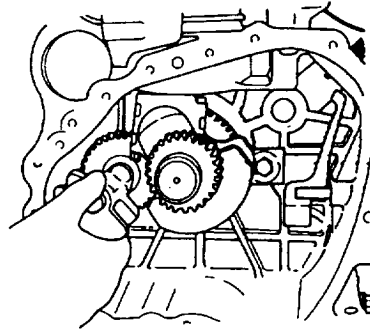


Figure 6-12 Removing the balancer shaft

### 6-3.18 Piston and Connecting Rod Assembly

(Refer to Figure 7-5 or 7-16)

- 1) Remove the connecting rod bolts (see Figure 6-13).
- 2) Remove the big end cap of connecting rod assembly.

Remove carbon deposited on the upper inside surface of the sleeve (before extracting the piston).

- 3) Move the crankshaft to the top of the stroke and pull out the piston.

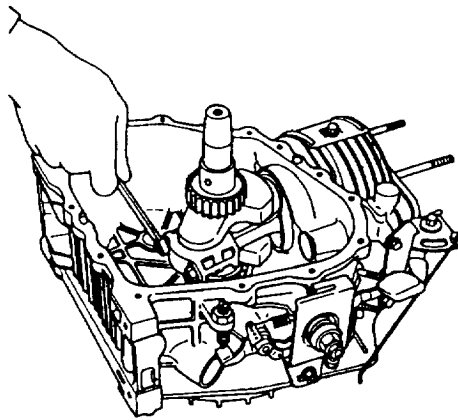


Figure 6-13 Removing the rod bolts and nuts.

### 6-3.19 Flywheel

(Refer to Figure 7-5 or 7-16)

- 1) Loosen the lock nut with the flywheel end nut wrench leaving the nut loose on shaft to control flywheel removal.
- 2) Extract the flywheel until loosened from crankshaft.
- 3) Remove locknut and flywheel using flywheel extractor (special tool). See Figure 6-14.

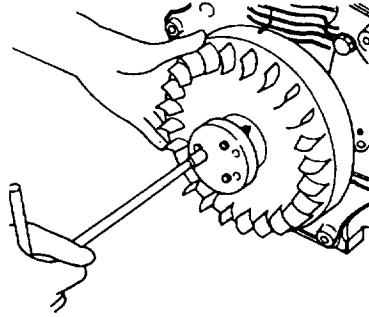


Figure 6-14 Removing the flywheel

### 6-3.20 Crankshaft

(Refer to Figure 7-5 or 7-16)

- 1) Remove the bearing retainer (see Figure 6-15).
- 2) Pull out the crankshaft (see Figure 6-16).

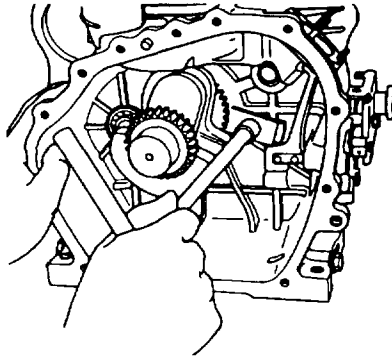


Figure 6-15 Removing the bearing retainer

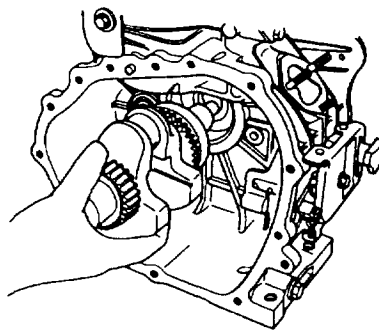


Figure 6-16 Pulling out the crankshaft

### 6-3.21 Governor Lever Assembly and Speed Control Device

(Refer to Figure 7-6 or 7-17)

Remove the governor lever assembly if damaged.

- 1) Remove the speed control device. Note the position of the governor spring before removal.

- 2) Remove the roll pin from the governor lever and shaft.

## **6-4. ENGINE REASSEMBLY PROCEDURES.**

### **6-4.1 Before Reassembly**

Thoroughly clean and check all parts.

Apply new engine oil to the sliding and rotating parts.

Use new packing and O-rings.

Use liquid packing agents to prevent oil leakage.

Make sure the clearance between parts (for oil, thrust, etc.) is correct.

When reassembling, line up matching marks on parts.

Use the proper bolts, nuts, and washer. Tighten the major bolts and nuts to the specified torque. (Be especially careful with aluminum alloy parts. These are easily damaged.)

Apply engine oil to threaded parts and flange faces before tightening the major bolts to the specified torque.

### **6-4.2 Governor Lever Assembly and Speed Control Device**

**(Refer to Figure 7-6 or 7-17)**

Reassemble the governor lever assembly and speed control device, if it has been removed. Damaged or scratches on the governor lever shaft can cause hunting and other problems.

### **6-4.3 Crankshaft**

**(Refer to Figure 7-5 or 7-16)**

- 1) Insert the crankshaft.
- 2) Attach the key (flywheel) to the crankshaft.
- 3) Install the bearing holder (see Figure 6-17).

Make sure that the crankshaft has been inserted as far as it will go.

Apply grease to the lips of the new oil seal. (Use GAA grease for U.S. Navy units)

Apply oil to the crankshaft journal and pin bearing surfaces.

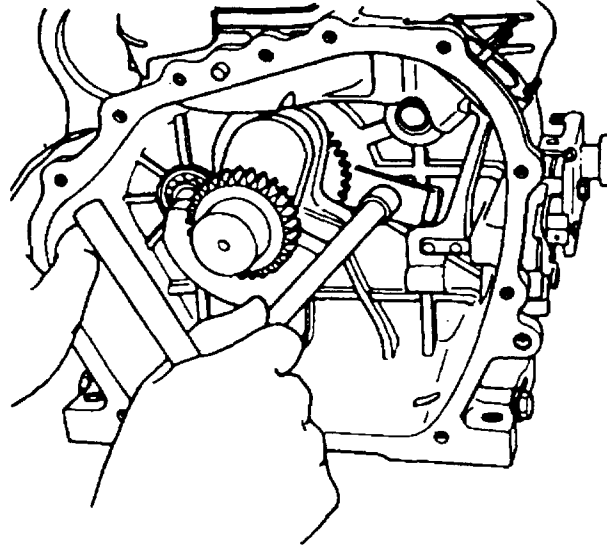


Figure 6-17 Installing the bearing retainer

#### 6-4.4 Piston and Connecting Rod

(Refer to Figure 7-5 or 7-16)

Apply oil to the crank shaft bearing surface.

Install the rings in the proper direction, with end gaps staggered 120 degrees.

Apply oil to the outer surface of the piston, bearing surfaces, and the inner surface of the sleeve.

Make sure the main bearing is in the proper position.

- 1) Assemble piston and connecting rod by heating piston to 158-176 degrees F. Before inserting piston pin into piston, make sure a clip is installed on one side of the piston.
- 2) Make sure piston "D" mark faces the cover side of the engine when installing the piston.
- 3) The piston valve recess must face toward the installer.
- 4) Connecting rod marks should face the camshaft at installation.
- 5) Insert the piston and connecting rod assembly, move the crankshaft to Top Dead Center. The mark on the piston head should face the crankcase cover side.
- 6) Install the connecting rod bearing insert (top half).
- 7) Install the big end cap (see Figure 6-18).

#### NOTE

THE CONNECTING ROD TIGHTENING TORQUE IS 375-425(27.1-30.7)  
KG-CM (LB-FT)



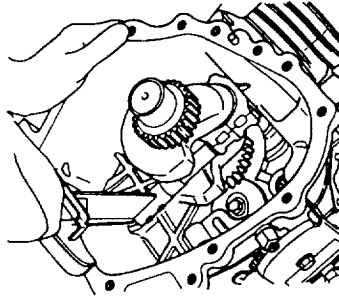


Figure 6-18 Installing the connecting rod big-end cap

#### 6-4.5 Camshaft, Balancer Shaft

**(Refer to Figure 7-5 or 7-16)**

Do not confuse exhaust and intake tappets.

Make sure the gears' matching marks are lined up.

- 1) Insert the tappets into the block in the order removed.
- 2) Insert the camshaft.
- 3) Insert the balancer shaft (see Figure 6-19).

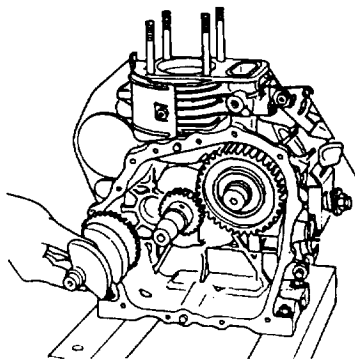


Figure 6-19 Inserting the balancer shaft

#### 6-4.6 Fuel Injection Pump Reassembly

**(Refer to Figure 7-8 or 7-19)**

Make sure the adjusting shims are used correctly. Reinstall the original shims.

Reassemble the fuel injection pump and tappet (see Figure 6-20).

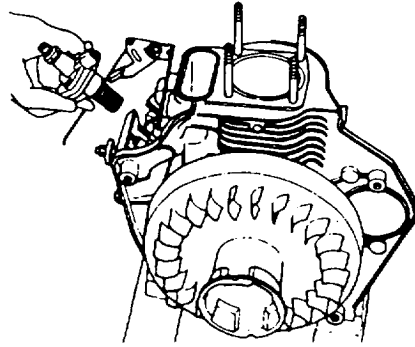


Figure 6-20 Installing the fuel Injection pump

#### 6-4.7 Crankcase cover

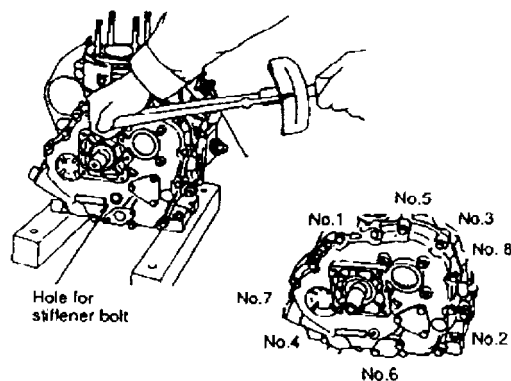
(Refer to Figure 7-2 or 7-13)

- 1) Place a new crankcase gasket between the surface of the crankcase and the crankcase cover.  
To protect the oil seal, attach the guide for inserting the oil seal to the shaft prior to insertion.  
Apply grease to the lips of the oil seal. Use GAA grease for U.S. Navy units.  
Apply oil to the crank and camshafts.  
Make sure that the oil pump drive gears are properly engaged.

#### NOTE

THE CASE COVER TIGHTENING TORQUE IS 200-230 (14.5-16.6) KG-CM (LB-FT)

- 2) Reassemble the crankcase cover. (Tighten bolts in the sequence shown in Figure 6-21. Tighten bolts diagonally). Attach the crankcase cover and tighten bolts in three stages until maximum torque is reached.



Attaching the crankcase cover and tightening follow the order.

Figure 6-21 Attaching the crankcase and tightening sequence

#### NOTE

THE STIFFENER BOLTS TIGHTENING TORQUE IS 200-230 (14.5-16.6) KG-CM (LB-FT)

- 3) Stiffener bolts have been added on the crankcase cover to reduce vibration and noise. For an engine with stiffener bolts, tighten them after the bolts on the periphery of the crankcase cover are tightened.

#### 6-4.8 Flywheel

(Refer to Figure 7-5 or 7-16)

#### NOTE

THE FLYWHEEL TIGHTENING TORQUE IS 2,200-2,300 (159.2-166.3) KG-CM (LB-FT).

Tighten the flywheel with the flywheel end nut wrench (see Figure 6-22).

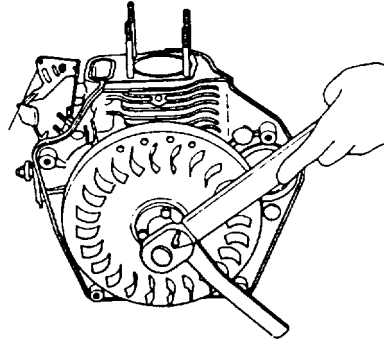


Figure 6-22 Tightening the flywheel

#### 6-4.9 Fuel Injection Pump Reassembly (Final)

(Refer to Figure 7-8 or 7-19)

#### NOTE

THE FUEL INJECTION PUMP TIGHTENING TORQUE IS 100-120 (7.2-8.7) KG-CM (LB-FT).

Install new insulators.

Tighten the fuel injection pump

See "Fuel Injection Volume limitation" section.

#### 6-4.10 Cylinder Head

(Refer to Figure 7-3 or 7-14)

- 1) Place a gasket on the cylinder block.
- 2) Attach an O-ring.

Before reassembling the valve spring, place its identification mark (white paint) toward the cylinder head.

- 3) Reassemble the cylinder head.
- 4) Tighten separately in two stages; the first stage, torque to 300 (21.7) kg-cm (lb-ft), and the second stage, 540-580 (39-41.9) kg-cm (lb-ft). See (Figure 6-23).

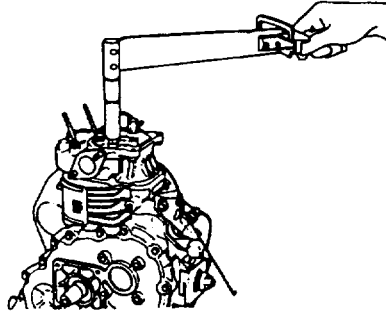


Figure 6-23 Tightening the bolts of the cylinder head

#### 6-4.11 Push Rods

**(Refer to Figure 7-5 or 7-16)**

Ascertain that the tappets are properly inserted.

Insert the push rods.

#### 6-4.12 Valve Rocker Arm Assembly

**(Refer to Figure 7-3 or 7-14)**

1) Install valve caps.

Be careful not to lose or damage the spring pin.

#### NOTE

THE VALVE ROCKER ARM TIGHTENING TORQUE IS 430-470 (31.1-34.0)  
KG-CM (LB-FT).

- 2) Reinstall the valve rocker arm assembly. Install the intake and exhaust rocker arms on the rocker arm support making sure that the rocker arms line up with the valve stems when the assembly is installed on the head (see Figure 6-24).
- 3) Adjust the valve clearance. Intake/ Exhaust valve head clearance: 0.15 mm (0.006 in./cold state)

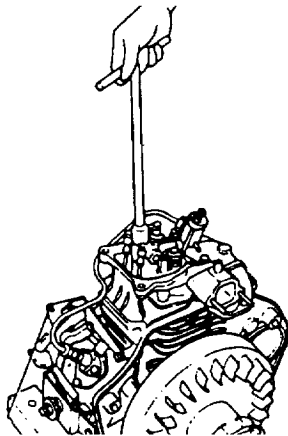


Figure 6-24 Tightening the valve rocker arm

#### 6-4.13 Valve Rocker Arm Cover

Install the valve rocker arm cover.

Make sure the gasket is in position.

#### 6-4.14 Fuel Injection Valve

- 1) Insert the fuel injection valve (see Figure 6-25).
- 2) Install the injection pipe.
- 3) Tighten the injection valve.

Make sure the fuel injection valve faces to the proper direction.

Replace the nozzle gasket. Make sure that the nozzle gasket and spacer are in position.

#### NOTE

THE FUEL INJECTION VALVE TIGHTENING TORQUE IS 100-120 (7.2-8.7) KG-CM (LB-FT).

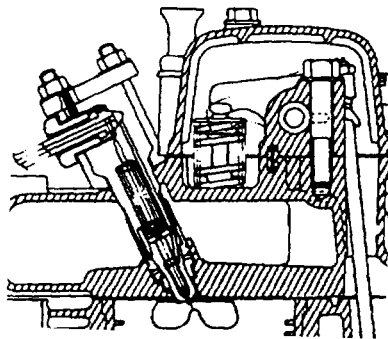


Figure 6-25 Install the fuel Injection valve

#### 6-4.15 Intake Bend

Install the intake bend.

Make sure the intake bend packing is in position.

#### 6-4.16 Cooling Fan Case

- 1) Install the starter pulley.
- 2) Install the cooling fan case with the fan case seal. (Reattach the recoil if it has been removed.)

Make sure the collar and fan case cushion rubber are in the proper position (see Figure 6-26).

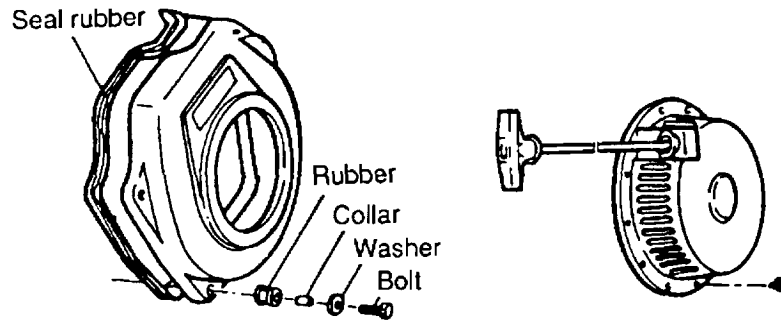


Figure 6-26 Cooling fan case recoil starter

#### 6-4.17 Air Cleaner

- 1) Attach the air cleaner case.
- 2) Install the element.
- 3) Install the cover (see Figure 6-27).

Make sure the intake bend and gasket are in position (see Figure 6-28).

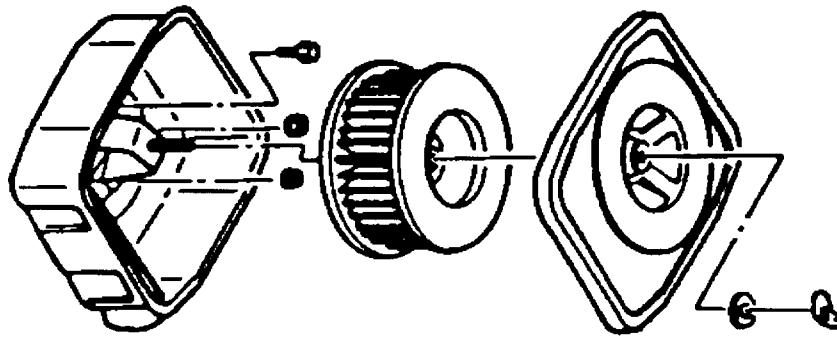


Figure 6-27 Air Cleaner

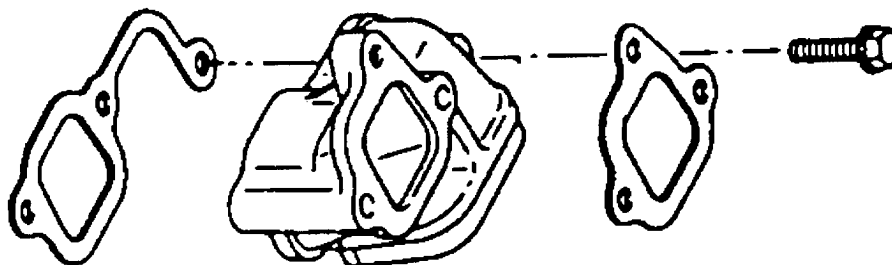


Figure 6-28 Intake bend

#### 6-4.18 Exhaust Silencer

Install the exhaust silencer.

#### 6-4.19 Fuel Tank

- 1) Connect the fuel pipe to the fuel injection pump.
- 2) Attach the fuel tank using the upper stay.
- 3) Insert the fuel return pipe to the fuel tank.

Make sure the fuel tank supporting rubber (vibration absorbing rubber) stays in place.

### 6-5. RECOIL STARTER.

The recoil starter will not be trouble in normal usage. However, should it break, or when it must be lubricated, disassemble and reassemble it according to the following procedures:

#### 6-5.1 Recoil Starter Disassembling Procedures.

- 1) Remove the recoil starter from the engine.
- 2) Pull out the grip and draw out the starter rope for approx. 30 cm. When the reel's notch came at the outlet of the starter rope, fasten the reel's turning by your thumb and draw up the starter rope inside the recoil starter using a screwdriver as shown in [Figure 6-29](#). Then, wind back the rope until the reel stops to turn by turning the reel with your thumb at the reel's notch.

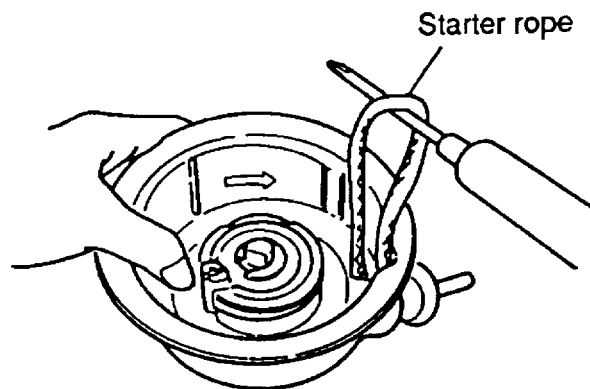


Figure 6-29 Recoil starter rope

- 3) Remove the parts as shown in [Figure 6-30](#).

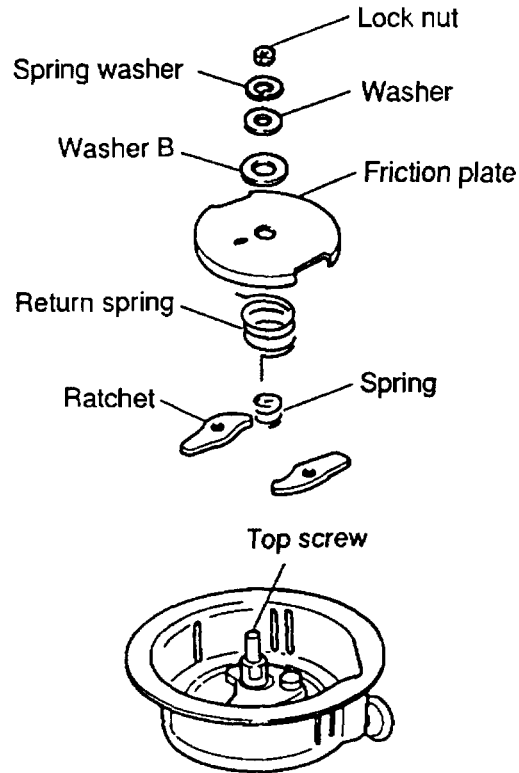


Figure 6-30 Recoil starter parts

- 4) Remove the reel from the starter case as shown in [Figure 6-31](#). Take out the reel slowly while turning it lightly to the left and right to remove the spring. Take care not to take out the reel quickly. Otherwise, the spring may jump out its housing' (if the spring runs out of position, put it in the starter case as described in [Paragraph 6.5.2](#)).

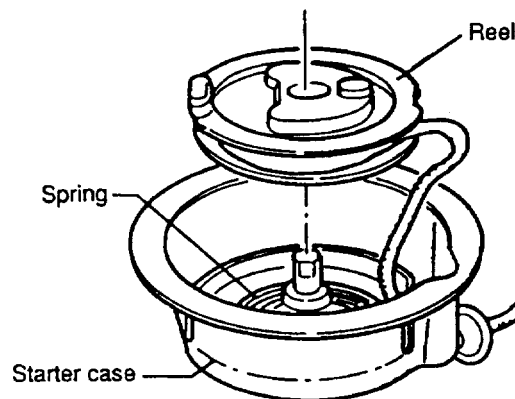


Figure 6-31 Recoil starter reel

#### 6.5.2 Recoil Starter Assembling Procedures.

- 1) Check that the spring is set correctly in the starter case housing. Adjust the shape of the inner end of the spring to locate it at about 4 mm from the starter shaft to ensure that the reel's hook engages with the spring correctly. See [Figure 6-32](#). (The inner end of the spring can be reshaped by pliers for a length of about 10 mm.)



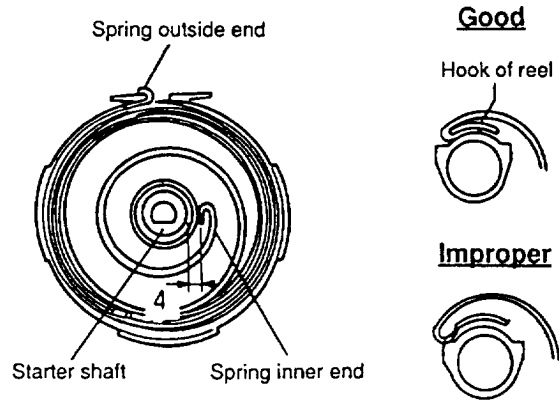


Figure 6-32 Recoil starter spring

- 2) Wind the starter rope around the reel to the arrow mark direction as shown in [Figure 6-33](#). Take out the rope from reel's notch at the 2.5 turns, fit the reel's hook to the inner, end of the spring, and reassemble the reel correctly into the starter case. (The reel's hook can't be seen on reassembly, so take care to reassemble correctly.)

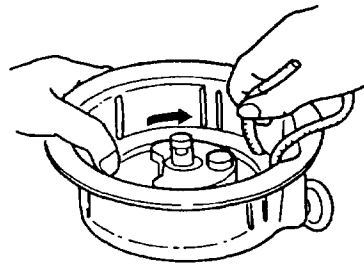


Figure 6-33 Recoil starter rope

- 3) Hold the starter rope as shown in [Figure 6-34](#). Wind it 4 turns in the arrow direction while securely holding the reel so that the rope may not be reversed. Lead the starter rope from the inside to outside. Slowly turn the reel in reverse.
- 4) Assemble the removed parts in the reverse order of the disassembly above.

When setting the friction plate, first set the return spring slightly lift and then insert it into the mating hole of the friction plate.

Turn the friction plate a little to the arrow direction. When the ratchet boss aligns with the guide, assemble the thrust washer and the E-ring while securely pressing down the friction plate to the reel. (Place the E-ring in the groove of the starter shaft once manually, and then fasten it with the pliers.)

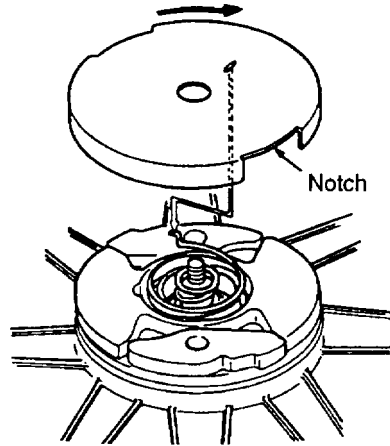


Figure 6-34 Recoil starter assembly

### **CAUTION**

**THIS COMPLETES THE DISASSEMBLY AND REASSEMBLY. BE SURE TO CHECK THAT ALL THE PARTS ARE REASSEMBLED CORRECTLY ACCORDING TO THE FOLLOWING PROCEDURES.**

#### Checks After Reassembly

- 1) Pull out the starter rope a little by pulling the grip 2 or 3 times.
  - (a) When the grip is too heavy to pull, check whether the parts are reassembled correctly.
  - (b) When the ratchet does not move, check whether the friction spring is reassembled.
- 2) Pull out the starter rope for the full stroke with drawing the grip.
  - (a) When the starter rope is left inside the reel or the starter rope will not return at all, an undue force is applied to the spring. In this case, rewind the starter rope one or two turns according to the procedures under [Paragraph 6.5.2.2](#).
  - (b) When the return of the starter rope is weak, or the grip hangs down in the midway, lubricate the friction parts with several drips of engine oil. When the failure can't be corrected still, rewind the starter rope one or two turns. (Check whether an undue force is applied to the spring, according to the procedure in (d above.) XX
  - (c) When the spring is detached from the reel's hook and the starter rope can't be wound inside the reel, follow the reassembly procedure again.

## **6-6. CYLINDER HEAD.**

### 6-6.1 Combustion Surfaces

Remove the fuel injection nozzle, intake valve, and exhaust valve. Clean the valve combustion surface or check for cracks or other damage. Use the dye penetrant test to check for minute cracks.

### 6-6.2 Intake and Exhaust Valve Seats

The valve seats are cold-fitted in the cylinder head to improve its wear resistance (see [Figure 6-35](#)). Clean off

carbon deposited on the valve seats since carbon build-up, excessive wear and corrosion can cause compression leaks (See Table 6-1, Service Standards).

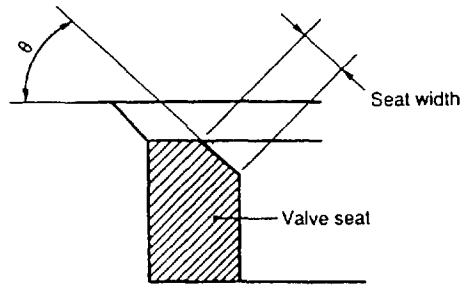


Figure 6-35 Valve seats

Valve seats are chilled by the liquid nitrogen and inserting to the cylinder head. (temperature difference: 190-200°C (374-392° F))

#### 6-6.3 Intake/Exhaust Valves, and Valve Guides (see Figure 6-36)

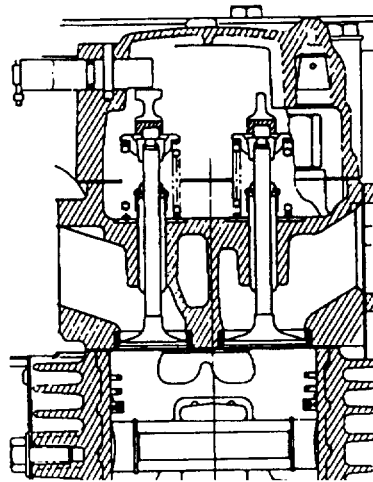


Figure 6-36 Intake/exhaust valve assembly

- 1) Check the valve stem for wear and distortion and replace if necessary. Do not confuse the intake and exhaust valve stems (see Figure 6-37).

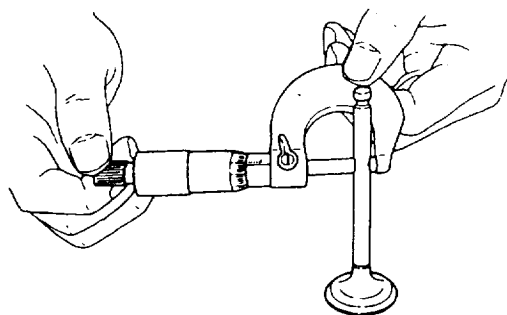


Figure 6-37 Valve stem

- 2) Check the valve sinkage (see [Figure 6-38](#)). Replace worn out valves (See service limits Table [6-1](#)).

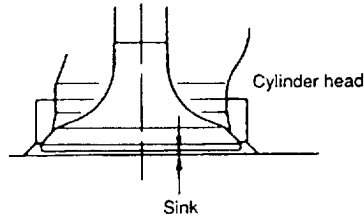


Figure 6-38 Valve sinkage

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE [6-1](#).

**CAUTION**

**THE INTAKE/EXHAUST VALVE GUIDES ARE PROVIDED WITH A VALVE STEM SEAL. STEM SEALS CANNOT BE REUSED AND MUST BE REPLACED WITH NEW ONES (see [Figure 6-39](#)).**

**CAUTION**

**WHEN INSERTING THE INTAKE AND EXHAUST VALVE, APPLY LUBRICATING OIL TO VALVE STEM.**

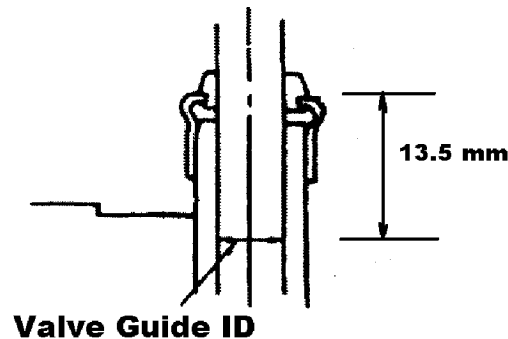


Figure 6-39 Valve stem seal

#### 6-6.4 Valve Spring

- 1) Check the valve spring for flaws and corrosion.
- 2) Measure the free length.
- 3) Measure the spring inclination (how far the spring inclines to the left or right).
- 4) Measure the spring tension (on a spring tension tester) (see [Figure 6-40](#)).

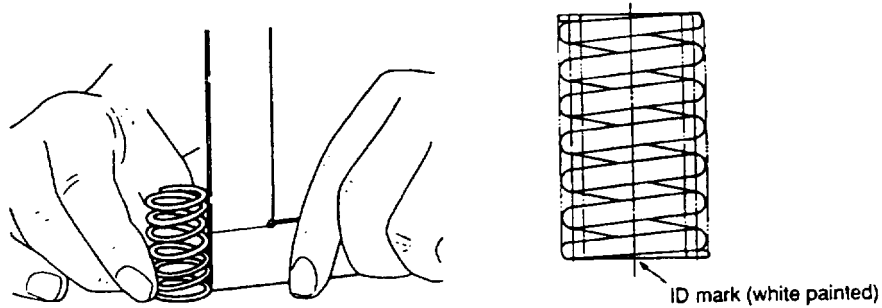


Figure 6-40 Valve spring

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

**CAUTION**

**WHEN ASSEMBLING THE VALVE SPRING, PLACE THE IDENTIFICATION MARK (WHITE PAINTED) OF THE VALVE SPRING TOWARD THE CYLINDER HEAD.**

## 6-6.5 Measuring the Top Clearance

- 1) Remove the cylinder head. Place high quality plastigage or unleaded solder fuses at three points on the upper part of the piston.
- 2) Reassemble the gasket packing and the head. Tighten them to the specified torque in the specified tightening order.
- 3) Press down the fuses with the piston by turning the crankshaft in its normal direction.
- 4) Remove the cylinder head and take out collapsed fuses. Measure the thickness of three crushed fuses. Instead of removing the cylinder head, thread a string tied to the fuse through the nozzle hole, pull it out to bring the fuse on the cylinder head as shown in Figure 6-41, and apply step (3) described above.
- 5) The top clearance is the average of the three measured thicknesses. Obtain the mean value of the three thicknesses (see Figure 6-41).

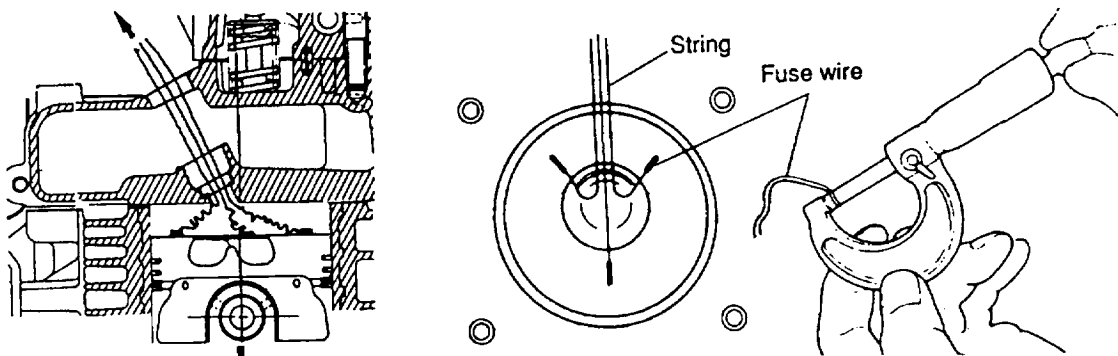


Figure 6-41 Measuring the top clearance

## 6-6.6 Intake and Exhaust Valve Rocker Arms and Push Rods

- 1) Valve rocker arm support. Measure the O.D of the shaft and the I.D. of the valve rocker arm. Replace the valve rocker arm shaft or valve rocker arms if it exceeds the service limits (see [Figure 6-42](#)).

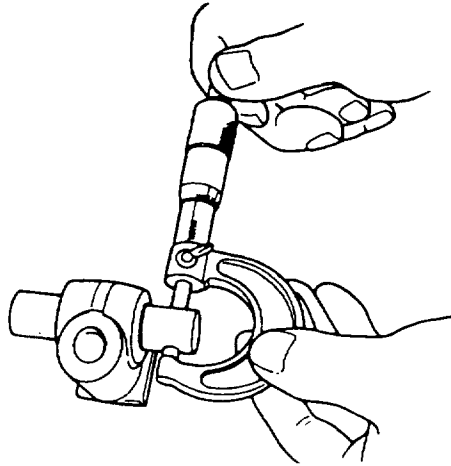


Figure 6-42 Valve rocker arm

- 2) Push rods. Check the push rod length and distortion.

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

#### 6-6.7 Adjusting the Valve Clearance

- 1) The valve clearance should be adjusted while the engine is in the cold state (see [Figure 6-43](#)).

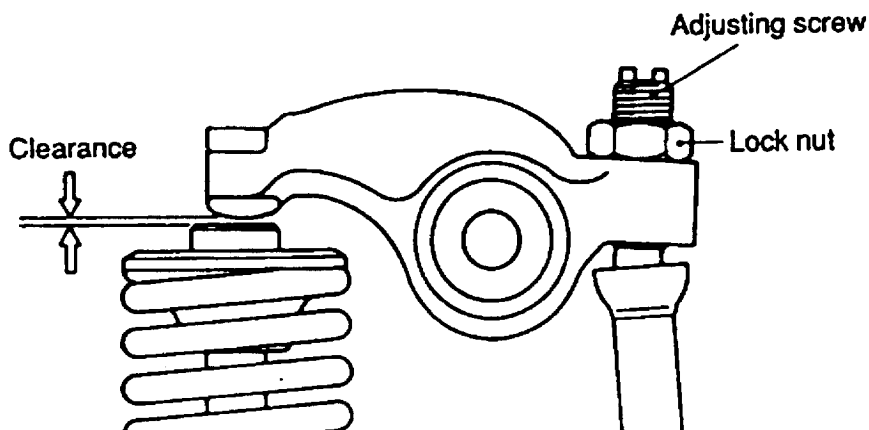


Figure 6-43 Valve clearance

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

- 2) The service standard table also shows the proper valve timing.

## 6-7. PISTON AND PISTON PIN.

### 6-7.1 Piston

#### 1) Checking the Piston top and combustion surface

Remove carbon build-up on the piston top and combustion surface. Be careful not to scratch the surface. Check the combustion surface for damage.

#### 2) Checking and measuring piston O.D.

- (a) Replace the piston if the outer surface and ring groove are damaged excessively.
- (b) Measure piston O.D. across the piston pin approx. 12 mm (0.47 in.) from the bottom end of the piston (see [Figure 6-44](#)).

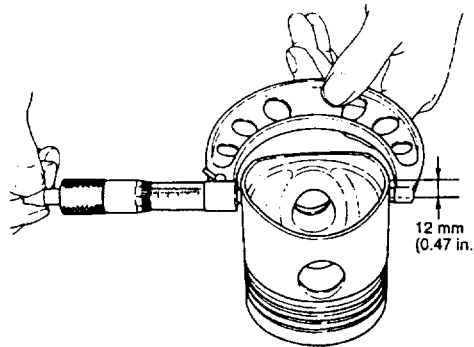


Figure 6-44 Checking piston O.D.

#### 3) Piston and piston pin

To remove piston pin, heat piston to 70-80°C (158-176°F), before extruding it.

To reassemble it, repeat the same step.

### 6-7.2 Piston Pin

Measure the O.D. of the piston pin. Replace if it worn exceeds the service limit or excessively stepped and worn.

### NOTE

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

### 6-7.3 Checking Piston Pin Hole

- 1) Replace the piston if the pin hole is discolored or damaged.
- 2) Measure the I.D. of the piston pin hole. If it exceeds the service limits, replace the piston (see [Figure 6-45](#)).

- 3) Piston replacement procedure: Heat the piston to 70-80°C (158-176°F) . Install "C" clip against the side of the piston with letters. Align the small end hole with the piston pin hole, then, insert the piston pin into the hole. Install "C" clip.

**NOTE**

HEAT THE PISTON IN OIL. AVOID HEATING IT DIRECTLY.

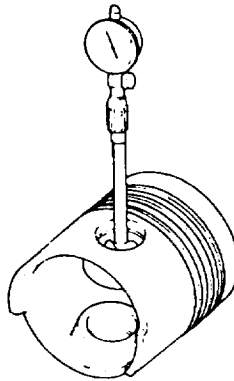


Figure 6-45 Checking piston pin hole

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

#### 6-7.4 Piston Rings (see [Figure 6-46](#))

##### 1) Measuring piston rings

Measure the thickness and width of the piston ring. Insert the piston ring into the piston ring groove and measure the clearance (see [Figure 6-47](#)).

Replace the piston ring if it exceeds the service limit.

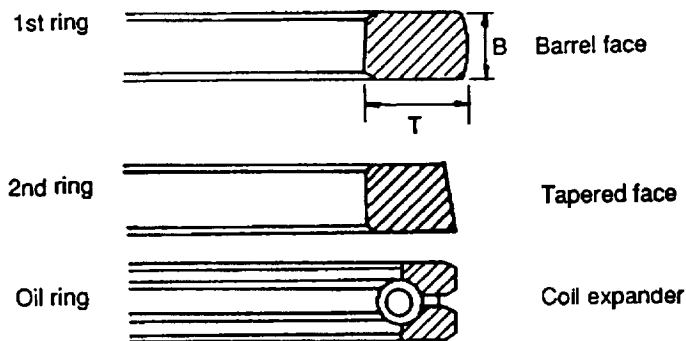


Figure 6-46 Ring configuration



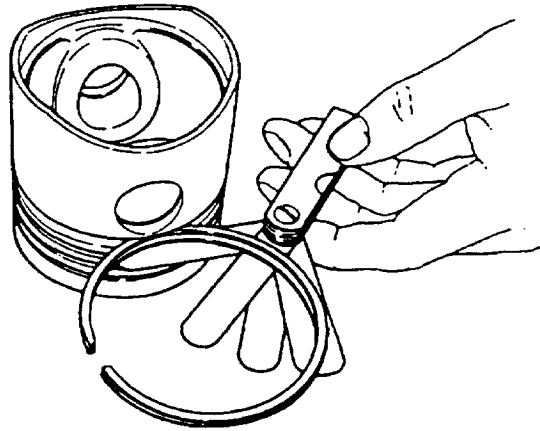


Figure 6-47 Measuring the clearance between the piston ring and groove (Side clearance)

## 2) Measuring piston ring end gap.

Measure the ring end gap by using a new cylinder, which is free from wear. If measuring the clearance in an engine which is in use, measure at the lower part of the cylinder as this will be most free from wear. Push the ring into the cylinder with the piston top (see [Figures 6-48 and 6-49](#)).

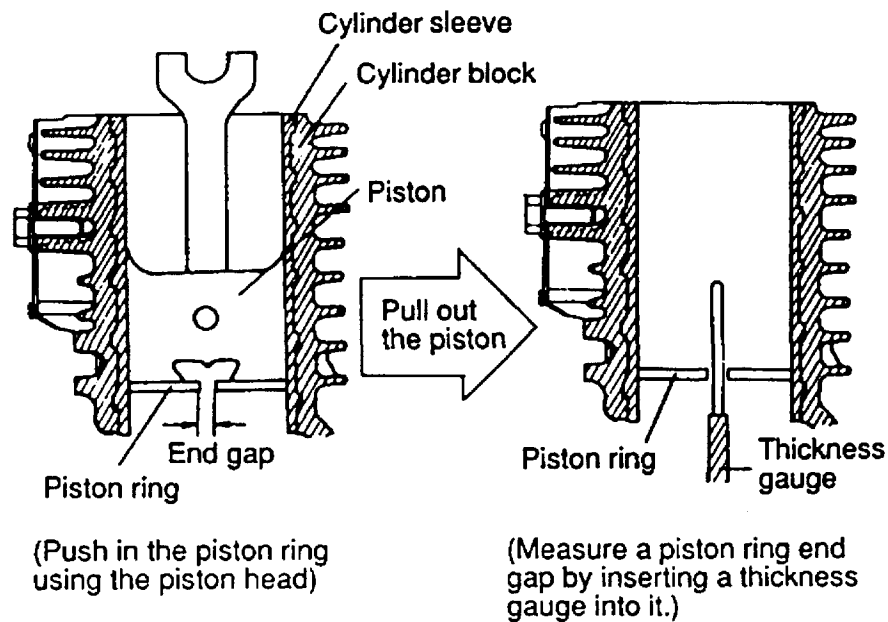


Figure 6-48 Measuring of ring end gap

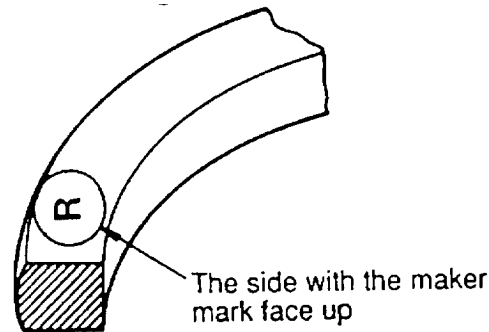


Figure 6-49 Measuring of ring end gap, continued

### 3) Cautions when replacing piston rings

- (a) Use the piston ring remover to attach or remove the piston ring. Never stretch the piston ring.
- (b) Carefully clean the ring groove. The end gap of the top ring should face the intake side.
- (c) When inserting the ring, the maker should face up.
- (d) Make sure the ring moves smoothly.
- (e) When inserting the coil expander into the oil ring, make sure the coil expander joint is opposite to the ring end gap.
- (f) Make sure each piston ring gap is 120 degrees apart (see [Figure 6-50](#)).

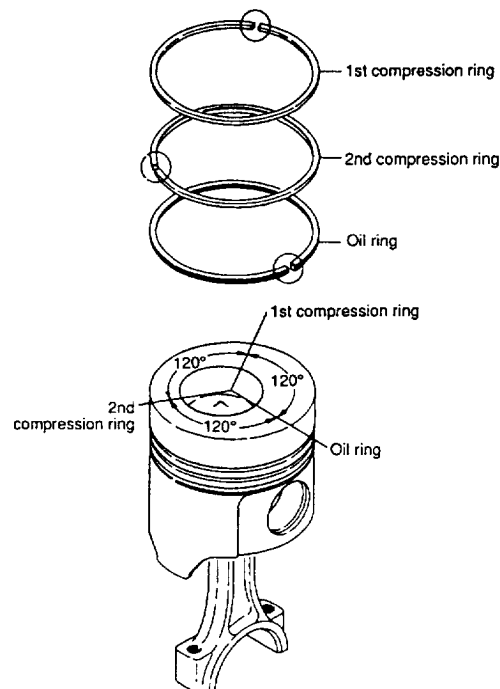


Figure 6-50 Piston rings

## 6-8. CONNECTING ROD.

### 6-8.1 Checking the Connecting Rod

- 1) Parallelness or distortion of the large and small end holes.

Check the large and small end holes of the connecting rod for parallelness or distortion.

Replace the rod if it is bent beyond the allowable limit (see [Figure 6-51](#)).

#### NOTE

THE ALLOWABLE LIMIT PLACED ON CONNECTING ROD PARALLELNESS OR DISTORTION IS 0.05(0.0020) MM(IN.).

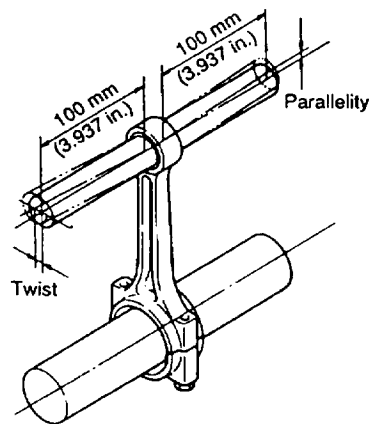


Figure 6-51 Connecting rod

- 2) Side gap of connecting rod

Re-attach the connecting rod to the crank pin to make sure the side gap in the crankshaft direction is proper. Make sure the thrust surfaces on both ends are not damaged.

#### NOTE

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

### 6-8.2 Checking the Crank Pin Metals

- 1) Check the contact surface of the crank pin metals for separation, melting seizure, etc. (see [Figure 6-52](#)).

Replace it if it is separated or damaged.

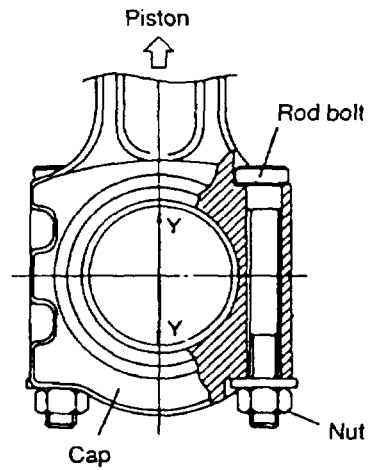


Figure 6-52 Check of crank pin metal

- 2) Measuring clearance between crank pin and crank pin bearing metals (see [Figure 6-53](#) and [Figure 6-54](#)). (Use plastigage)
  - (a) Remove the bearing cap and wipe the oil from the bearing metals and crank pin .
  - (b) Insert a plastigage into the cap on the large end in the crankshaft direction (see [Figure 6-53](#)).

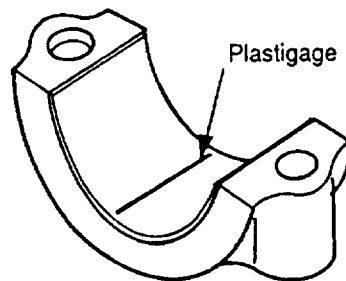


Figure 6-53 Plastigage

- (3) Attach the connecting rod to the crank pin and tighten the connecting rod to the specified torque.
- (4) Remove the rod and measure the crushed plastigage with the measuring scale.

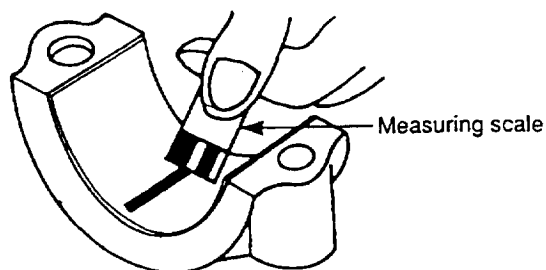


Figure 6-54 Measuring the crank pin metal clearance

**NOTE**

THE TIGHTENING TORQUE OF THE CONNECTING ROD IS 375-425(27.1-30.7) KG-CM(LB-FT).

### 6-8.3 Measuring Clearances Between Crank Pins and Crank Pin Bearing Metals.

Line it up using the undersized crank pin metal if it exceeds the service limit.

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

#### 6-8.4 Connecting the Piston and Connecting Rod

Line up the position of the piston top mark and the matching marks on the connecting rod as shown in the illustration. When inserting the piston into the cylinder, position the piston top mark so that it faces the crankcase cover side (gear box) (see [Figure 6-55](#)).

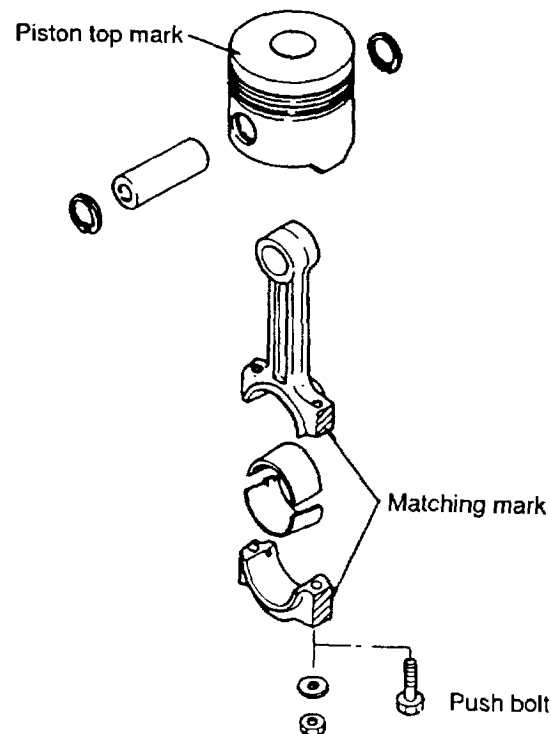


Figure 6-55 Line up the piston and connecting rod

### 6-9. CRANKSHAFT, MAIN BEARING AND FLYWHEEL.

#### 6-9.1 Crankshaft

##### 1) Stem color check

Clean the crankshaft and check for flaws using the dye penetrant or by magnaflux inspection. Replace the crankshaft if it is cracked or badly damaged.

##### 2) Measuring the crank pin and journal

Check the crank pin and journal for surface wear. If the pin and journal are worn beyond the allowable limit, replace the crankshaft assembly (see [Figure 6-56](#)).

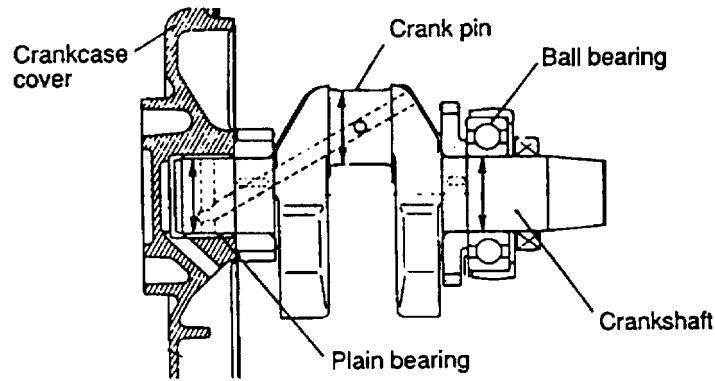


Figure 6-56 Crank pin and journal

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

- 3) The ball bearing on the flywheel side has been press-fitted onto the crankshaft.  
Replace the crankshaft assembly (crankshaft and bearing) if it is loosened or damaged.

## 6-9.2 Main Bearing Metal

- 1) Checking the metal (metal on the crankcase cover side)

Replace the main bearing metal if it is discolored, separated, or damaged in any other way.

The main bearing metal has been press-fitted into the crankcase cover. Align oil hole in the metal with oil groove as illustrated in [Figure 6-57](#).

**CAUTION**

**MOUNT THE METAL SO THAT THE OIL GROOVE FACES UP.**

**CAUTION**

**THE SINKAGE SHOULD BE 1 MM (0.0394 IN.) FROM THE THRUST SURFACE.**

Carefully fit the main bearing metal so that the oil groove is on the upper half.

Align the oil hole in the bearing metal with the oil groove (see [Figure 6-57](#)).

(Positioning the main bearing metal) Measure an oil clearance between the main bearing metal and jour-

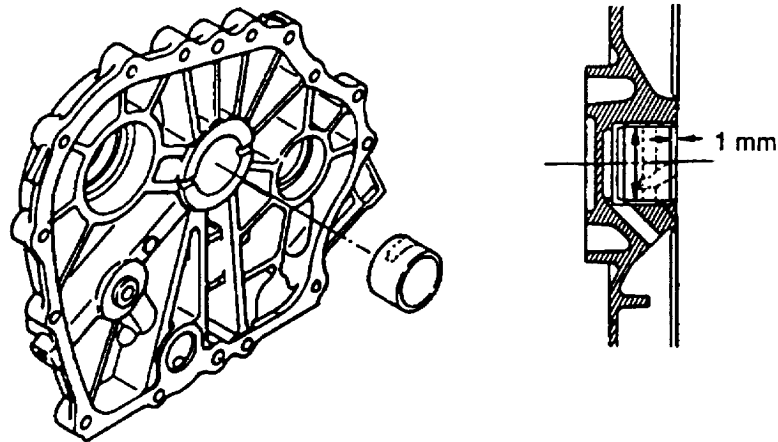


Figure 6-57 Align the oil hole in the bearing metal  
nal. If an oil clearance exceeds the allowable limit, add an undersized bearing metal.

#### NOTE

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

### 6-9.3 Flywheel

#### 1) Timing mark

Fuel injection timing mark for measurement are on the periphery of the flywheel (see [Figure 6-58](#)).

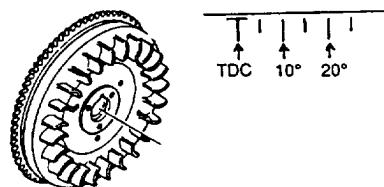


Figure 6-58 Timing mark

#### 2) Ring gear

Ring gear has been shrink-fitted on the flywheel at approximately 180 degrees C (356 degrees F) (see [Figure 6-59](#)).

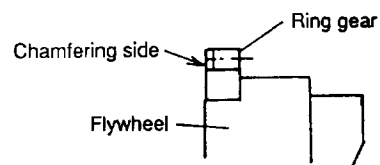


Figure 6-59 Ring gear

### 6-9.4 Camshaft and Tappet

## 1. Camshaft

### 1) Checking the clearance at the thrust of the camshaft (cylinder block side)

Check the clearance at the thrust of the camshaft. The camshaft bearing has been press-fitted into the cylinder block. Maintain the sinkage between the press-fitted bearing face and the thrust surface of cylinder block at 1.4-1.5 mm (see [Figure 6-60](#)).

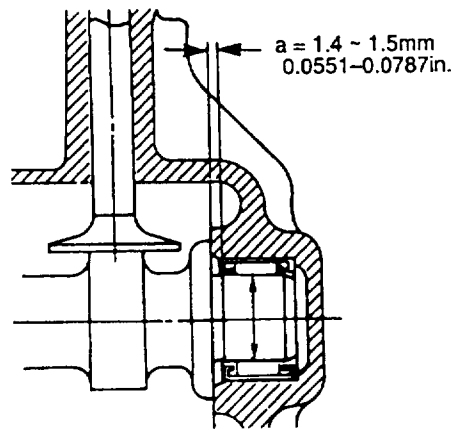


Figure 6-60 Camshaft thrust clearance

- 2) Measuring the camshaft and bearing (Crankcase cover side) Measure the I.D. of the ball bearing and O.D. of the camshaft. Replace the ball bearing if it exceeds the wear limit or is badly damaged (see [Figure 6-61](#)).

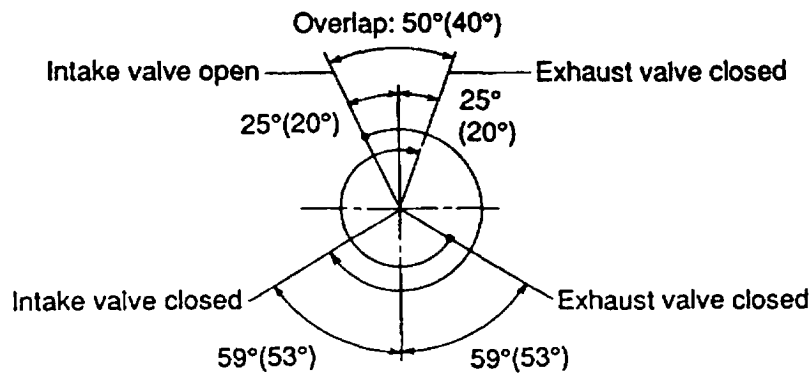


Figure 6-61 Valve timing (valve clearance in cold state: at 0.15 mm)

## NOTE

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

## Tappet

- 1) Check the condition of the tappet contact point. The tappet is offset with regard to the cam center and rotated during operation to prevent uneven wear. Replace the tappet if it is badly worn or contacts the cam unevenly.
- 2) Check the outer surface of the tappet for wear and damage. Replace if defective.



**CAUTION**

**KEEP THE INTAKE AND EXHAUST TAPPETS SEPARATE DURING DISASSEMBLY OR REASSEMBLY.**

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

### 6-9.5 Timing Gears

#### Checking the Timing Gears

- 1) Check each gear and replace those gears or gear assemblies that are damaged or worn.
- 2) When reassembling, line up the timing marks on each gear.

### 6-9.6 Crankcase Cover

Always handle the aluminum packing with care. When the crankcase cover is disassembled, replace the aluminum packing on the crankcase cover if damaged or deformed. Be sure to tighten the crankcase cover to the tightening torque values as specified in the [note](#) below. The crankcase cover is held in position by two positioning pins.

**NOTE**

THE TIGHTENING TORQUE VALUES FOR THE CRANKCASE COVER AND STIFFENING BOLTS ARE 200-230(14.5-16.6) KG-CM(LB-FT).

#### 1. Cleaning and checking

Clean the cylinder block when the engine is overhauled. Clean out each oil hole and make sure it is not clogged (see [Figure 6-62](#)). (Leave plugs in place if they do not need to be replaced. Protect the plugs from oil leaks.)

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

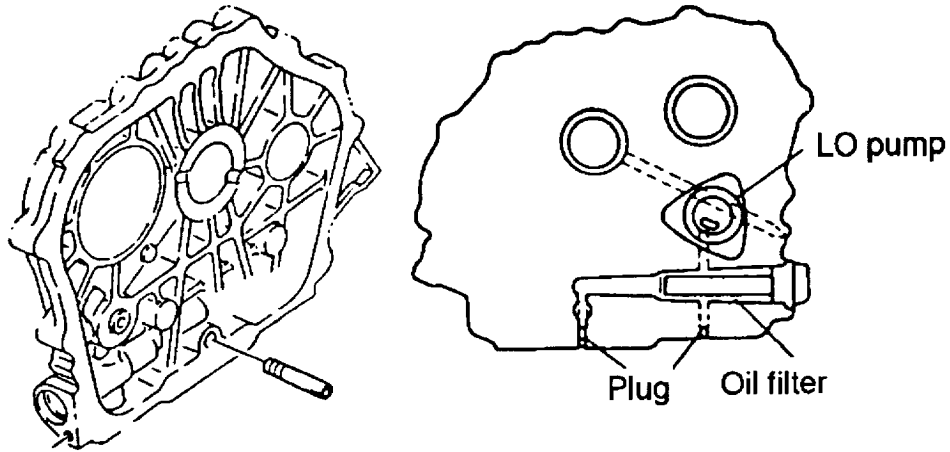


Figure 6-62 Oil hole and blind cover of the crankcase

### 6-9.7 Replacing the Crankshaft Oil Seals

When replacing oil seal, use special tool (see [Figure 6-63](#)).

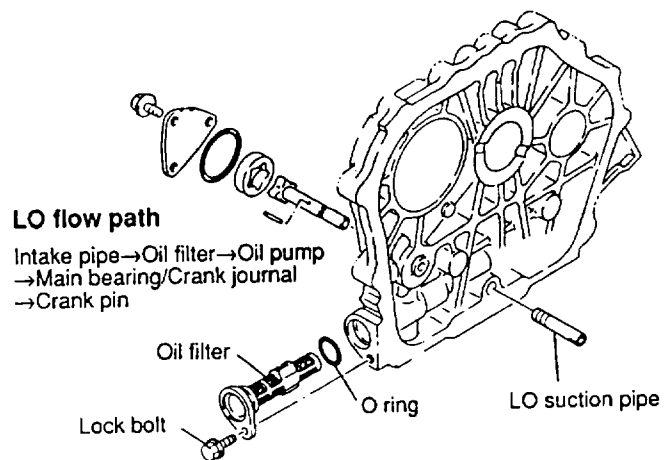


Figure 6-63 Crankshaft oil seals

### 6-9.8

Insert crankshaft oil seal into crankcase cover until it is 4 mm (0.1575 in.) deep from the end of crankcase (see [Figure 6-64](#)).

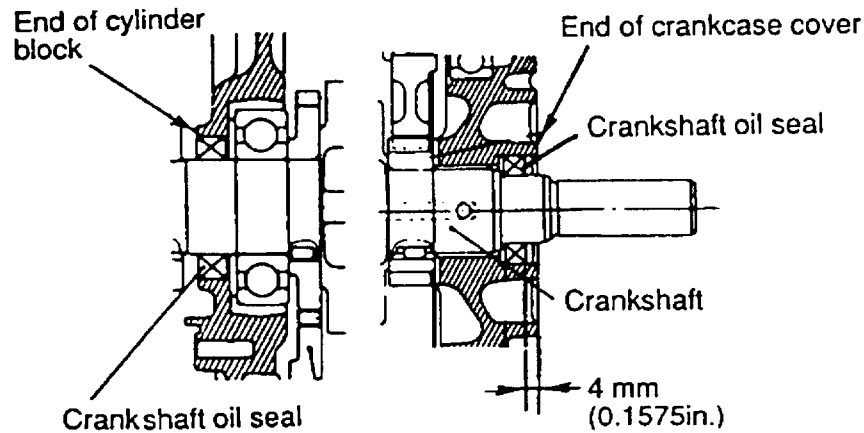


Figure 6-64 Cylinder block

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

### 6-9.9 Cylinder Sleeve and Cylinder Block

#### 1. Cylinder sleeve

The cylinder sleeve is cast in the aluminum die-casting cylinder block.

Measure the I.D. of the cylinder sleeve. Re-bore the cylinder sleeve if it exceeds the allowable limit and use with an oversized piston.. The oversized piston is available at either 0.25 (0.0098) or 0.50(0.0197) mm(in.) over-size (see [Figure 6-65](#)).

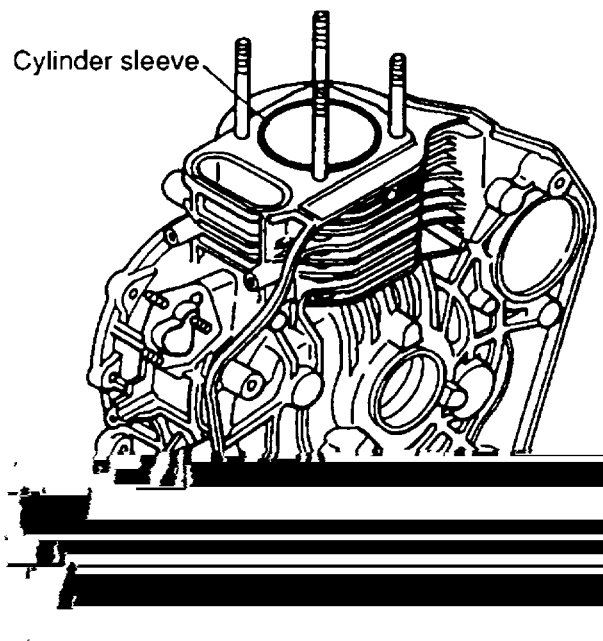


Figure 6-65 Cylinder block and cylinder sleeve

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

**NOTE**

THE STANDARD CYLINDER SLEEVE I.D. IS 86.000-86.030(3.3858-3.3870) MM(IN.) WITH A SERVICE LIMIT OF 86.18(3.3929).

**6-10. LUBRICATION SYSTEM.**

This engine adopts a forced oil lubrication system driven by a trochoid pump. Lubricating oil is circulated as follows. The rocker arm chamber is lubricated by moisture (see [Figure 6-66](#)).

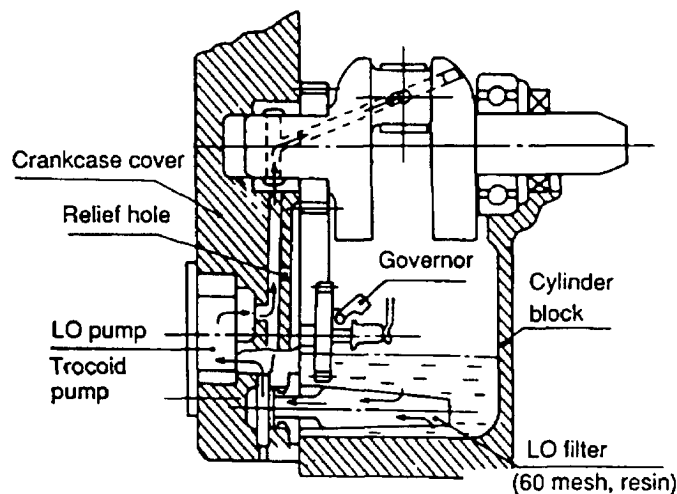


Figure 6-66 LO filter > Trochoid pump > Crankshaft > Crankpin metal (Lubricating oil route)

**6-10.1 Lubricating Oil Pump**

- 1) Measure the clearance between the outer rotor and body (crankcase cover). Replace the pump if the clearance exceeds the allowable limit.
- 2) Measure the clearance between the outer rotor and the inner rotor with a thickness gage. Replace the pump as a set if the clearance exceeds the allowable limit.
- 3) Installing the lubricating oil pump
  - (a) Insert the lubricating oil pump assembly from the outside of the crankcase cover. Coat the rotor with oil before installing the cover (see [Figure 6-67](#)).
  - (b) Insert the parallel pin into the lubricating oil pump shaft.
  - (c) Set the weight on the gear.
  - (d) Insert the spindle into the weight, then push the spindle into the shaft. Once in place, the spindle cannot be removed.

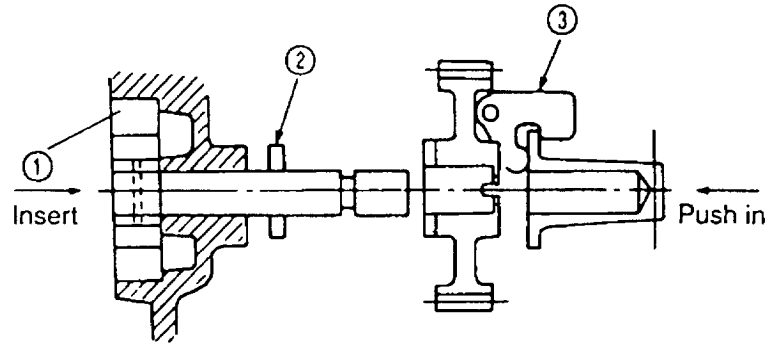


Figure 6-67 Installation of lubricating oil pump

**NOTE**

REFER TO THE APPLICABLE SERVICE STANDARD TABLE 6-1.

## 6-11. FUEL SYSTEM.

### 6-11.1 Fuel Injection Pump

- 1) Specifications: Model YPFE-M (see [Figure 6-68](#) and [Figure 6-69](#))

**CAUTION**

**THE ID MARKS THE PUMP IS ON THE PUMP MOUNTING FLANGE. NONE OF THESE FUEL INJECTION PUMPS IS INTERCHANGEABLE. THE FUEL INJECTION PUMP FOR DISCRETE ENGINE DIFFERS FROM THE GENERATOR IN THE DIRECTION OF THE FUEL INLET PIPE.**

**NOTE**

THE ADJUSTING SHIMS STANDARD THICKNESS (SHOP ASSEMBLY) IS 0.5(0.0197) MM(IN.).

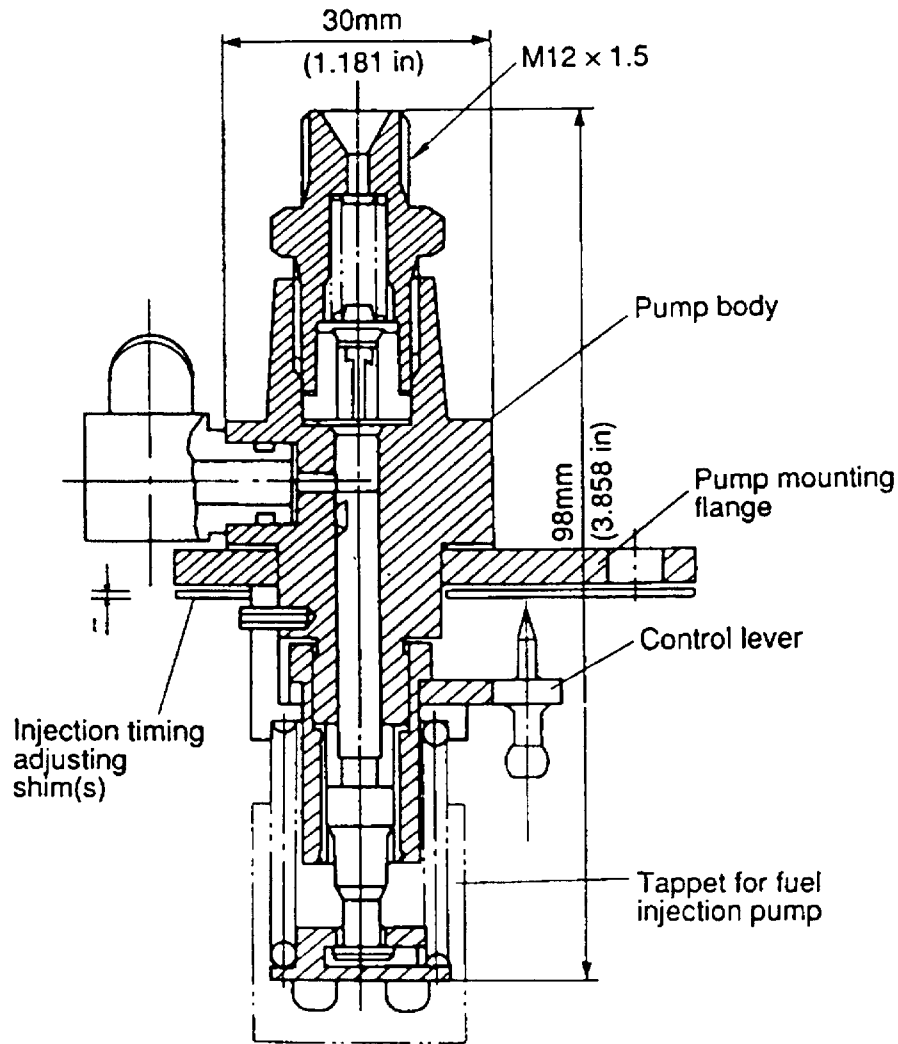


Figure 6-68 Configuration of fuel oil pump

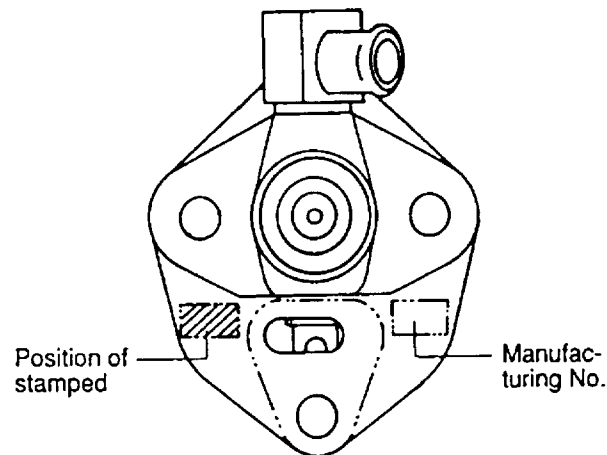


Figure 6-69 Fuel pump mounting flange

### 3) Disassembly and reassembly

This is standard fuel injection pump body.

Disassemble and reassemble the fuel pump in the direction order of "UP", "DOWN" and "SIDE" from the center of the fuel injection pump body (marked "C") as illustrated (see [Figure 6-70](#)).

Reassemble the gasket A and B for the delivery seat in the position at the time of disassembly.

**NOTE**

SEE THE POSITION OF MARK. NEVER REMOVE THE SUCTION PIPE JOINT FROM THE PUMP BODY DURING ROUTINE DISASSEMBLY.

**NOTE**

THE DELIVERY VALVE HOLDER TIGHTENING TORQUE IS 300-350(21.69-25.31) KG-CM(LB-FT).

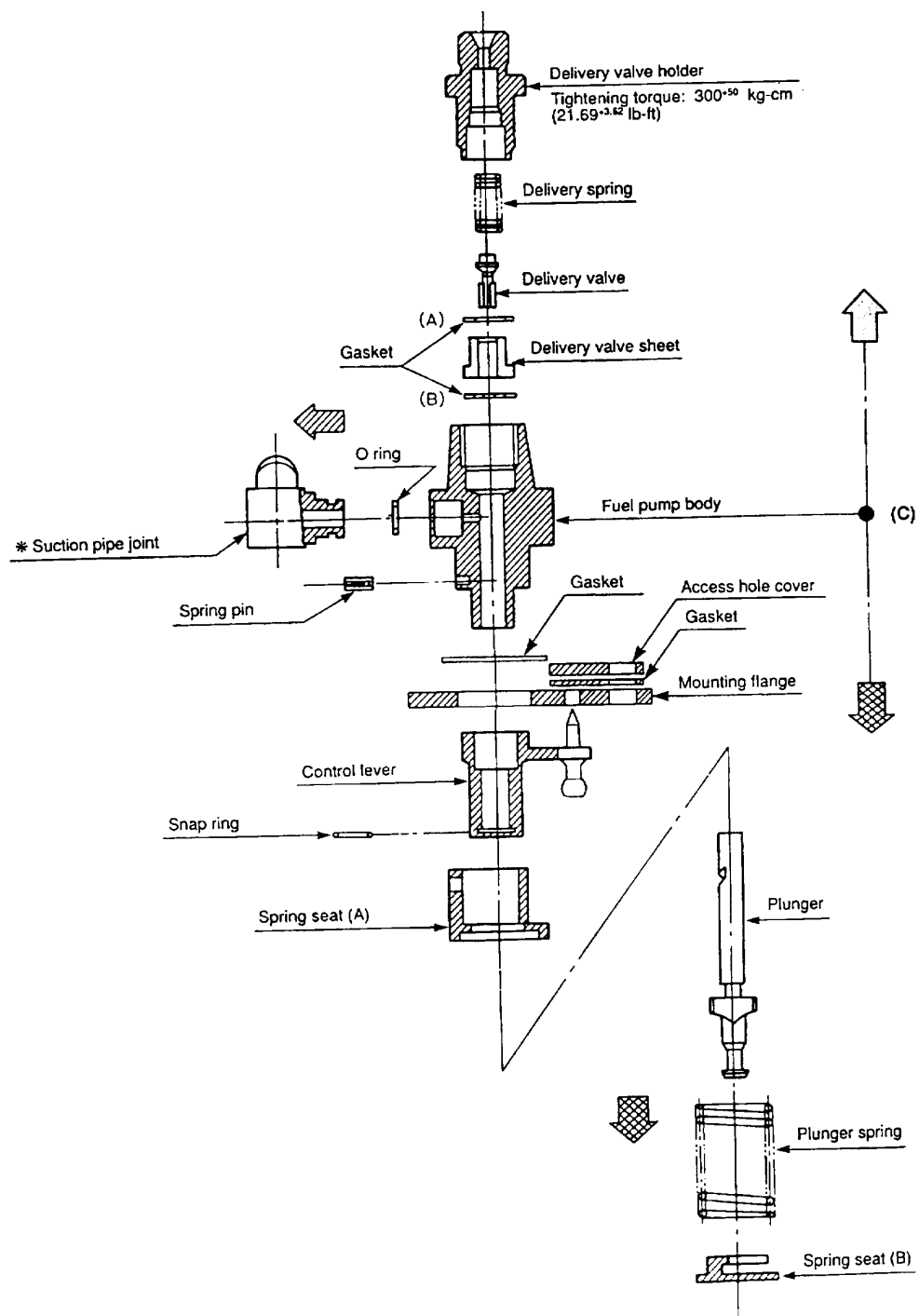


Figure 6-70 Fuel pump disassembly and reassembly



### 6-11.2 Fuel Injection Valve (see Figure 6-71)

- 1) Specifications Model: YDLLA -P (Mark to identify assembly "AF", mark to identify nozzle valve and nozzle body "YANMAR/150P/ 224B0).

Example: Symbol 150P indicates an injection angle of 150 degrees; symbol 224A1 implies 4 nozzle holes which are 0.22 mm in injection hole diameter.

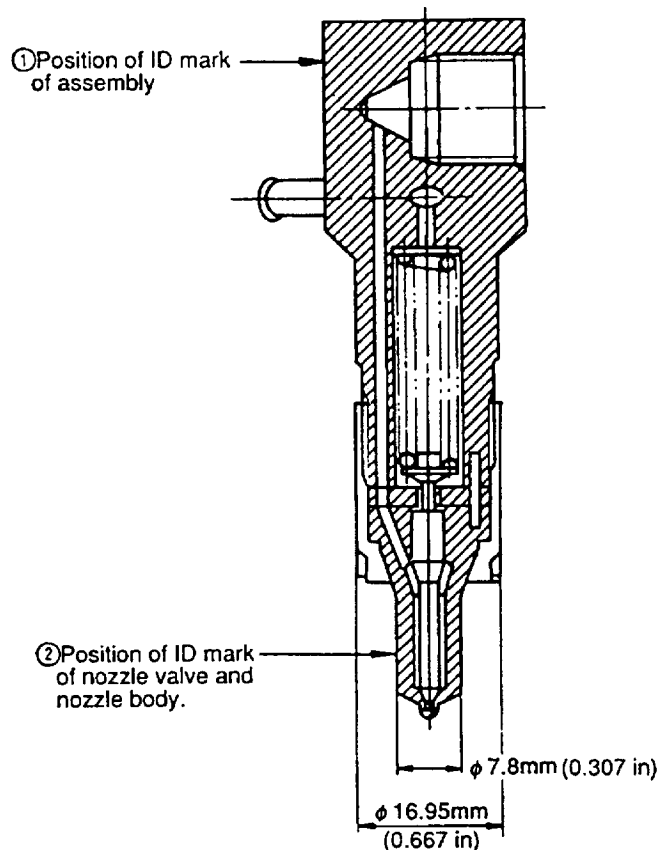


Figure 6-71 Structure of injection valve

#### **CAUTION**

**WHEN REPLACING FUEL INJECTION VALVE, BE SURE TO CHECK ENGINE MODEL AGAINST THE IDENTITY MARKS SHOWN ABOVE. ANY INJECTION VALVE IS LEAST IDENTIFIABLE IN APPEARANCE.**

#### **CAUTION**

**WHEN REMOVING THE FUEL INJECTION VALVE, WRAP IT IN CLOTH TO PROTECT THE NOZZLE TIP (INJECTION PORT). DO NOT PLACE THE NOZZLE TIP DIRECTLY ON THE GROUND.**

- 2) Check
  - (a) Carbon deposits (Flowering)

Carbon deposits build up on the nozzle in the form of flowers. Flowering lowers combustion performance significantly. Make sure the nozzle is free from contamination.

(b) Shape of injection spray

Move the lever of the nozzle tester at a speed of approximately 1.2 time/sec. to check the spray pattern.

Normal shape of spray

1. The spray should all be at the same angle (from all four injection ports)
2. The spray should be a fine mist.
3. The spray should be smooth and steady without deviations (4 nozzles).

3) Precautions when installing fuel injection valve

- (a) Tighten the fuel injection valve assembly to the specified torque.
- (b) Clean the sleeve surface. Be sure to replace the nozzle gasket at the same time.

**NOTE**

IF NOZZLE GASKET STAYS IN CYLINDER HEAD AFTER INJECTION VALVE ASSEMBLY HAS BEEN REMOVED FROM CYLINDER HEAD, SCREW M8 OR M9 STUD BOLT (MORE THAN 100 MM LONG) IN NOZZLE GASKET, THEN PULL OUT STUD BOLTS TO REMOVE GASKET (see [Figure 6-72](#)).

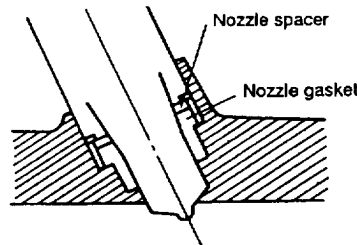


Figure 6-72 Fuel injection nozzle

**NOTE**

THE TIGHTENING TORQUE FOR INSTALLING THE FUEL INJECTION VALVE NUT IS 100-120(7.2-8.7) KG-CM(LB-FT). THE TIGHTENING TORQUE FOR INSTALLING THE FUEL INJECTION NOZZLE CASE NUT IS 400-450(28.9-32.5) KG-CM(LB-FT).

4) Disassembly and reassembly (see [Figure 6-73](#))

Remove the case nut, and then all parts of the valve can be disassembled. To disassemble and reassemble the case nut, use a 15 mm deep socket wrench.

The fuel valve positioning pin does not need to be removed.

5) Adjustment

The injection starting pressure is 200 kg. To adjust the nozzle injection starting pressure, remove the nozzle holder and increase or decrease the number of adjusting shims.

Adjustment by 0.1 mm results in a change in the injection starting pressure of about 20 kg/cm<sup>2</sup>.

Adjusting shims come in the following thicknesses: 0.1, 0.15, 0.4, 0.5, 0.6, 0.7, and 0.8 mm.

**NOTE**

THE ADJUSTING SHIM STANDARD THICKNESS IS 0.60-0.65(0.0236-0.0256) MM(IN.).

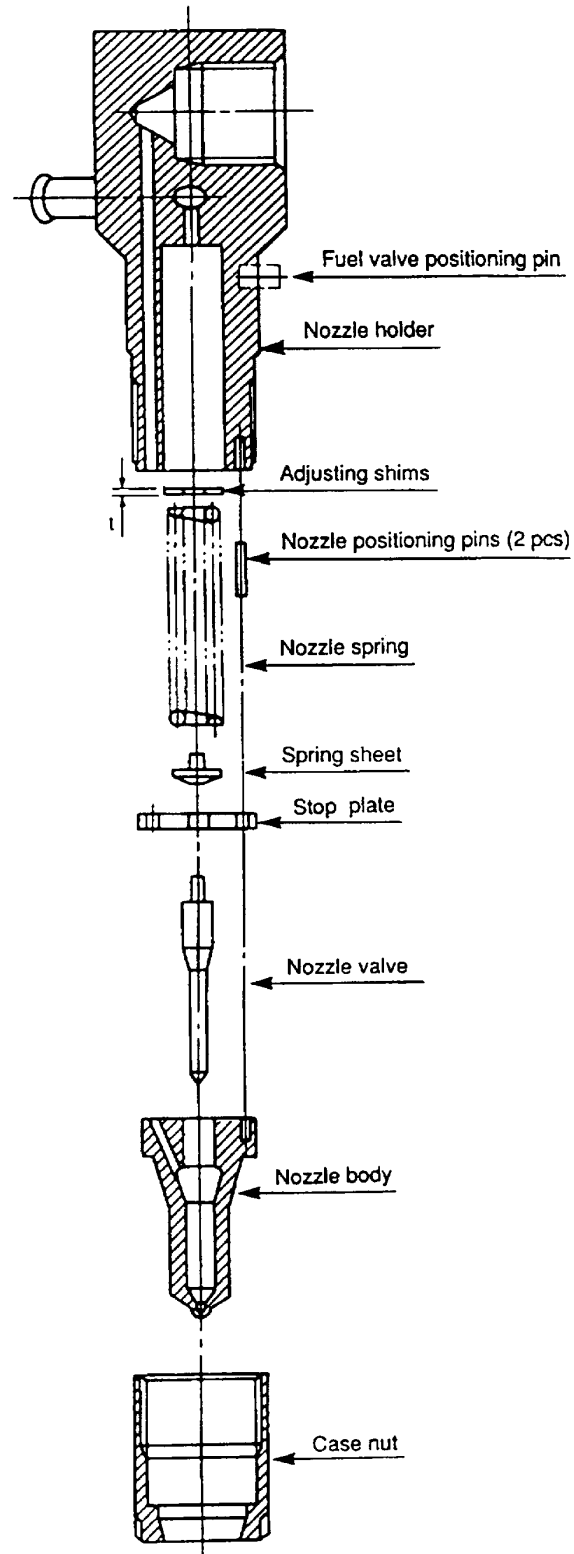


Figure 6-73 Fuel injection valve assembly

### 6-11.3 Fuel Filter

The fuel filter uses an element of nominal filterable particle diameter of 5 microns. During the periodical inspection of this part, check the element for break, separation from the frame to which it should be bonded, stoppage, etc., and if a defect is found, replace it with new one.

### 6-11.4 Speed Control Device

The position where governor spring must be installed differs depending on engine model and its rated rpm. Use Yanmar Type A throttle assembly setting. Top spring goes to hole position 3. Lower spring goes to center position of governor lever (see [Figure 6-74](#)).

Check the spring for position before ascertaining the fuel injection limit.

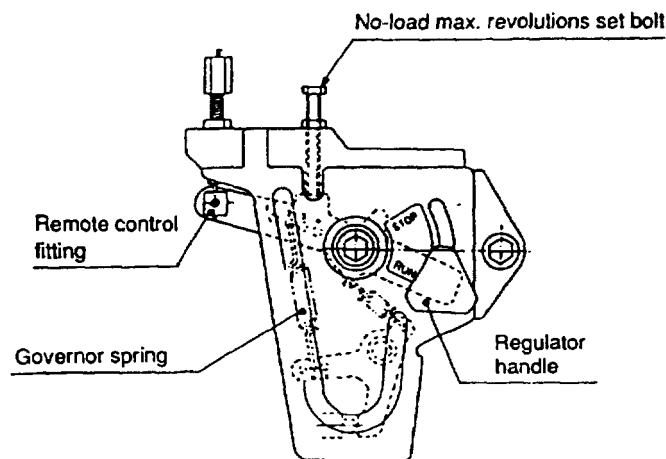


Figure 6-74 Type A

### 6-11.5 Adjustment

#### Adjustment of Fuel Injection Timing

Fuel injection timing must be precise. If it is too early or too late, a host of trouble will result in: difficulty in starting, knocking, lowered output, poor exhaust color, etc. Correctly adjust the governor linkage assembly and the injection pressure before adjusting the injection timing. When the engine is used for long periods of time, the injection pump plunger wears out and distorts the timing.

If the plunger is worn, replace it and readjust the injection timing.

#### 1) How to check the injection timing.

Set the speed control handle to "Run".

Remove the fuel injection pipe, and install the injection timing measurement pipe (see [Figure 6-75](#)).

Match the TD position mark on the flywheel with the V notch line on the cylinder body fin.

Turn the flywheel first clockwise then counterclockwise about 30° from the TD mark to make sure fuel is injected. (If it is not, turn the flywheel once)

Turn the flywheel slowly until fuel flows out of the pipe. When the fuel begins to flow, check the angle using the mark on the flywheel.

Repeat three or four times to make sure the reading is correct.

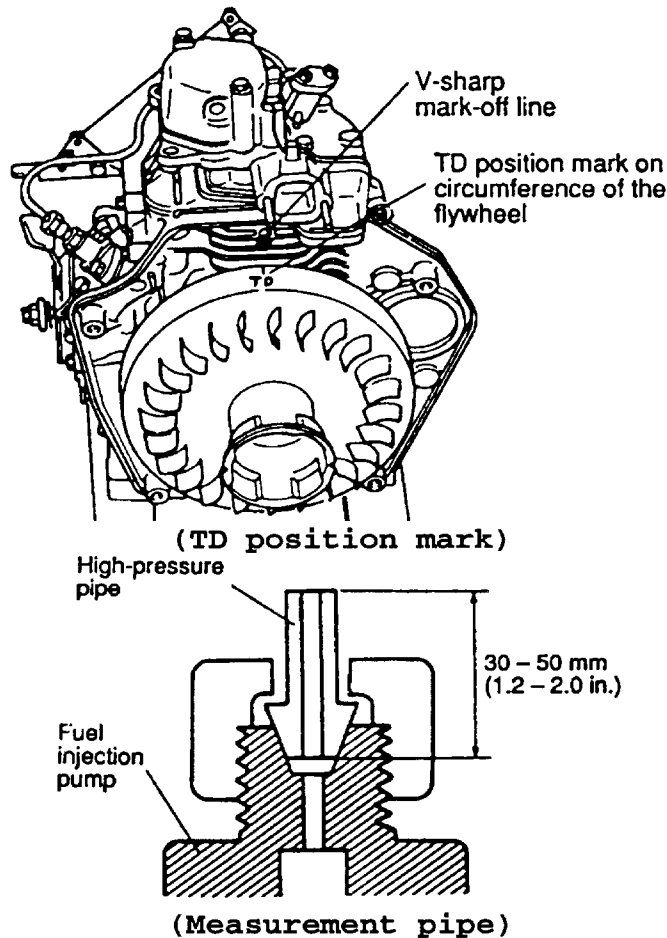


Figure 6-75 Measurement pipe

## 2) How to adjust the injection timing

Remove the fuel injection pump and base.

Add or remove adjusting shims. If the timing is fast, add shims. If the timing is slow, remove shims. Each 0.1 mm (0.0039 in.) changes the timing by 1 degree (FID).

### NOTE

THE INJECTION TIMING (FID BTDC) IS 12-14 DEGREES.

## Bleeding Air from Fuel System

Air can enter the fuel oil pipe system when the engine is first installed, the fuel oil pipe is removed, etc. Bleed the air according to the following instructions:

- 1) Place the speed control handle in the run position.
- 2) Open all cocks of the fuel system.

- 3) Set the decompression lever to the Non-compression position.
- 4) Make sure that fuel comes out from the fuel injection nozzle while pulling the recoil starter. Loosen the delivery valve holder to bleed the air easily. Re-tighten it to 300-350 (21.725.3) kg-cm(lb-ft) with a torque wrench.

#### Fuel Injection Volume Limitation

- 1) Adjustment before shipment. The control lever is fixed after the rated revolutions and injection quantity have been checked with the pump installed on the special purpose pump drive table. Then, a mark-off line is marked on the spring sheet to line up with the edge of the control lever (see [Figure 6-76](#)).

The access hole has an access hole pointer match mark. Make sure the mark-off line matches the edge of the control lever.

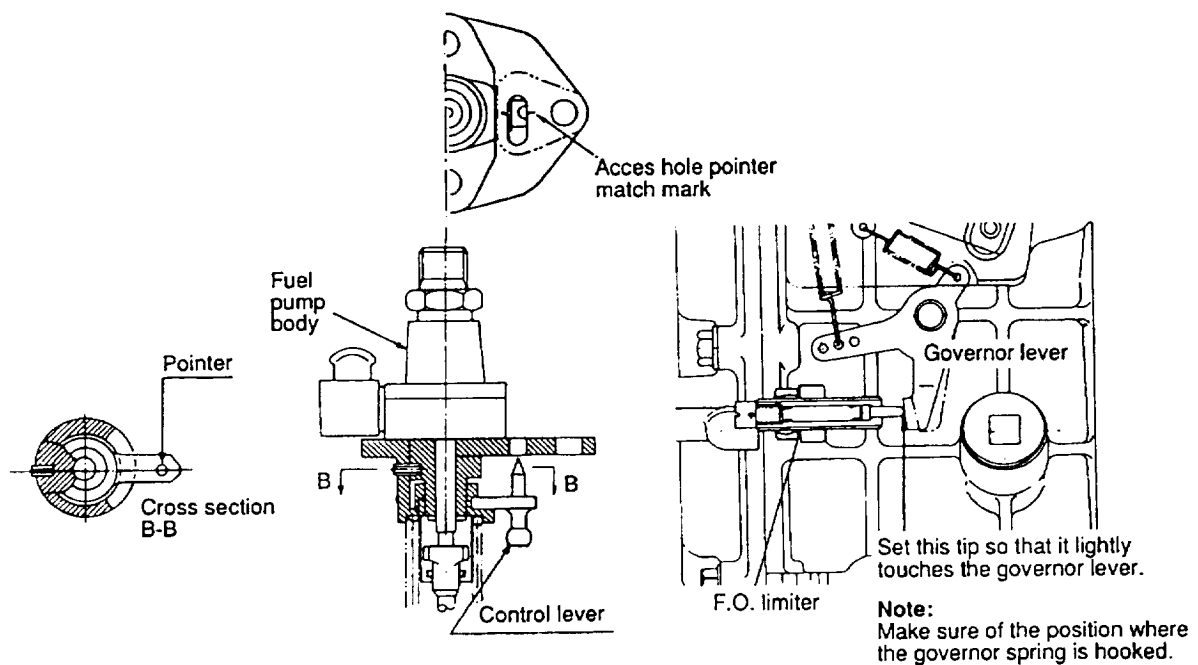


Figure 6-76 Fuel injection volume limitation adjustment

#### Adjusting the Clearance on Intake/Exhaust Valve Head

Check the clearance at the disassembly and reassembly, and every 500 hours of operation. Then adjust it if necessary.

#### NOTE

THE INTAKE/EXHAUST VALVE HEAD CLEARANCE IS 0.10-0.15(0.0039-0.0059) MM(IN.) MEASURED IN THE COLD STATE.

- 1) Adjustment

Adjust the clearance with a thickness gage (see [Figure 6-77](#)).

## **CAUTION**

**MAKE SURE EACH CYLINDER IS IN THE T.D.C BEFORE ADJUSTING THE CLEARANCE. THIS WAY THE INTAKE/EXHAUST ROCKER ARMS WILL NOT MOVE EVEN IF THE CRANKSHAFT IS TURNED CLOCKWISE OR COUNTERCLOCKWISE FROM THE TD MARK.**

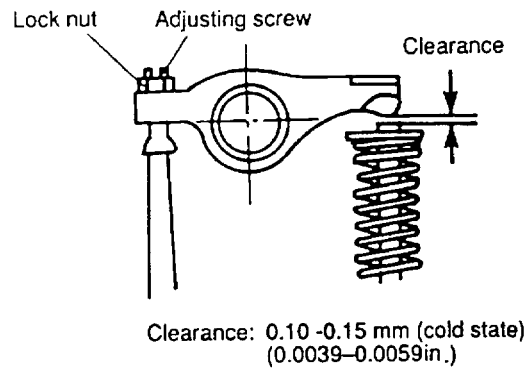


Figure 6-77 Adjusting the valve head clearance

## **6-12. TEST RUN.**

### 6-12.1 Before Starting

- (1) Check bolts and nuts and flywheel rotation
  - a) Check for loose lock bolts and nuts.
  - b) Turn the decompression lever in the non-compression direction. While turning the recoil starter several times, pay attention to abnormal sounds (see [Figure 6-78](#)).

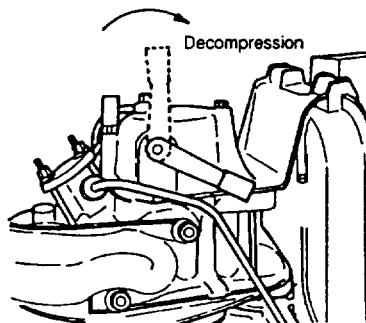


Figure 6-78 Decompression mechanism

- (2) Fuel. Open the drain cock and run out a small amount of fuel since water and other contaminants settle on the bottom (see [Figure 6-79](#)).



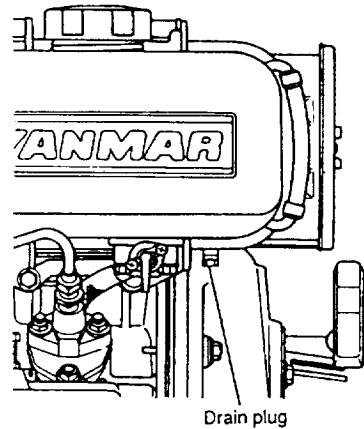


Figure 6-79 Fuel tank assembly

- (3) Lubricating oil
  - a) Use the specified lubricating oil.

### **CAUTION**

#### **NEVER MIX DIFFERENT BRANDS OF LUBRICATING OIL.**

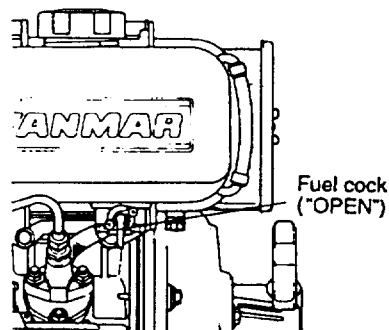
- b) Fill up the lubrication oil to the filler port (with the engine level).
- (4) Priming with lubricating oil
 

Turn the flywheel as follows to make sure oil gets to all engine parts.

  - a) Set the speed control handle to the STOP position.
  - b) Set the decompression lever to the "Non compression" position.
  - c) Turn the flywheel. (Make sure no abnormal sound occurs.)

## 6-12.2 Starting

- (1) Set the fuel cock to position "O" (open) (see [Figure 6-80](#))



(This figure shows the operating position.)

Figure 6-80 Starting (1)

- (2) Set the regulator handle to the "START" position, and tighten the knob (see [Figure 6-81](#)). (The FO limiter must be in the "increase" position. Otherwise, the engine may not start.)

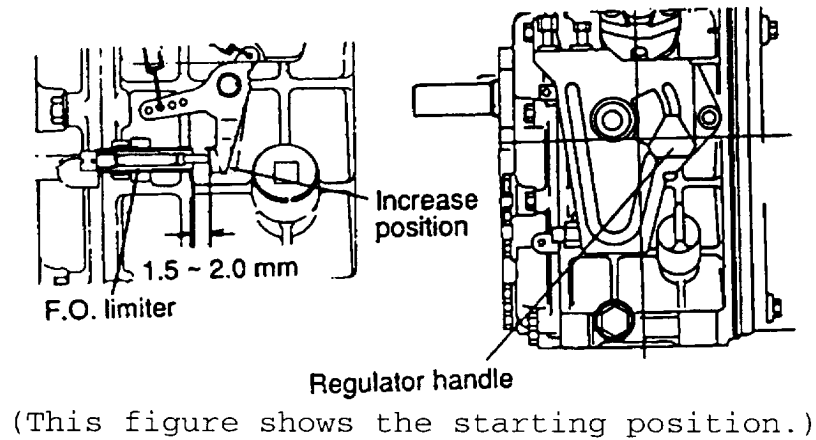


Figure 6-81 Starting (2)

- (3) Pull out the recoil starter handle.
  - a) Pull out the recoil starter handle grip slowly until it feels tight to pull, then let it back slowly.
  - b) Turn the decompression lever to "Non compression" by one hand. The decompression lever returns automatically when the recoil starter handle is pulled (see [Figure 6-82](#)).

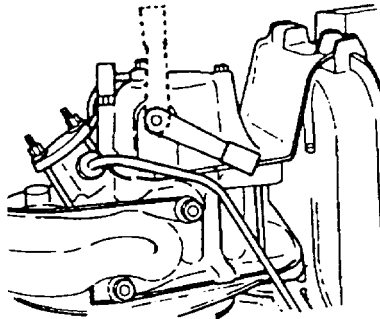


Figure 6-82 Starting (3)-2

- c) Grip the recoil starter handle with both hands and give a good, strong pull (see [Figure 6-83](#)).

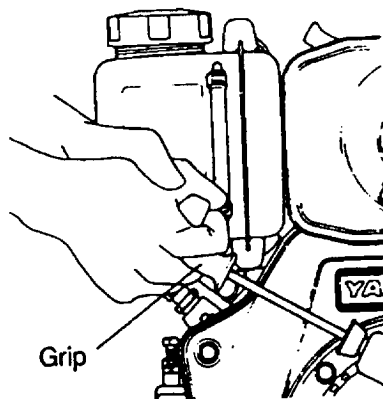


Figure 6-83 Starting (3)-3

### 6-12.3 Operation

- (1) Warm up the engine for about 5 minutes.
- (2) When the engine is warm, put the speed control handle in the required rpm position, and tighten the knob.

#### 6-12.4 Stopping

- (1) Turn the speed control handle to the low speed position. Run the engine in no-load state for about 5 minutes.
- (2) Turn the speed control handle to "STOP" .

### **CAUTION**

#### **ALWAYS ALLOW THE ENGINE TO COOL OFF BEFORE STOPPING.**

- (3) Return the fuel cock lever to "S." (closed)
- (4) Pull out the recoil starter handle slowly, then stop pulling when it feels tight.

**Table 6-1 SERVICE STANDARDS**

<b>L100AE-D</b>			<b>L100EE-D</b>	
<b>PARTS</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>
<b>INTAKE/EXHAUST VALVE SEATS</b>				
SEAT ANGLE	60°-90°	-	90°	-
SEAT WIDTH	1.5-3.0 (0.059-0.118)	-	1.4	-
<b>INTAKE/EXHAUST VALVES &amp; VALVE GUIDES</b>				
VALVE SINKAGE	0.3-0.7 (0.012-0.028)	1.1 (0.043)	0.4-0.8 (0.012-0.028)	1.1 (0.043)
VALVE GUIDE I.D. INTAKE/EXHAUST	7.0-7.015 (0.275-0.276)	7.08 (0.2787)	7.0-7.015 (0.275-0.276)	7.08 (0.2787)
VALVE STEM OD. INTAKE	6.960-6.975 (0.274-0.275)	6.90 (0.2717)	6.960-6.975 (0.274-0.275)	6.90 (0.2717)
EXHAUST	6.945-6.960 (2.734-2.740)	6.90 (0.2717)	6.945-6.960 (2.734-2.740)	6.90 (0.2717)
<b>VALVE SPRINGS</b>				
FREE LENGTH	40 (1.575)	39.5 (1.555)	40 (1.575)	39.5 (1.555)
INCLINATION	<1.0 (0.039)	-	<1 (0.039)	-
SPRING CONSTANT (KG/MM)	1.80-2.51 KG (3.97-5.51 LB)	-	1.611.97 KG (2.26-2.76 LB)	-
<b>INTAKE/EXHAUST VALVE ROCKER-ARM, ROCKER SHAFT AND PUSH RODS</b>				
INTAKE/EXHAUST ROCKER ARM SHAFT O.D.	14.989-15.000 (0.5901-0.5906)	14.90 (0.5866)	14.989-15.000 (0.5901-0.5906)	14.90 (0.5866)
INTAKE/EXHAUST ROCKER ARM I.D.	15.016-15.034 (0.5912-0.5919)	15.10 (0.5945)	15.032-15.045 (0.5912-0.5919)	15.10 (0.5945)
PUSH ROD LENGTH	196.8-197.2	-	196.8-197.2	-

**Table 6-1 SERVICE STANDARDS - Continued**

<b>L100AE-D</b>			<b>L100EE-D</b>	
<b>PARTS</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>
	(7.748-7.764)		(7.748-7.764)	
PUSH ROD DISTORTION	<0.05 (0.0020)	0.3 (0.0118)	<0.05 (0.0020)	0.3 (0.0118)
<b>VALVE CLEARANCE</b>				
INTAKE AND EXHAUST	0.10-0.15 ml (0.0039-0.0059) (cold state)	-	0.10-0.20 ml (0.0039-0.0079) (cold state)	-
<b>VALVE OPENING/CLOSING TIMING</b>				
INTAKE	OPEN	20° B T.D.C	22.3° B T.D.C.	-
	CLOSED	53° A B.D.C	54.7° A B.D.C.	-
EXHAUST	OPEN	53° B B.D.C	55.3° B B.D.C.	-
	CLOSED	20° A T.D.C.	21.7° A T.D.C.	-
<b>PISTON</b>				
PISTON O.D. OVERSIZE: 0.25MM, 0.50MM	85.965 (3.3844)	85.70 (3.3740)	85.995 (3.3841)	85.70 (3.3740)
CLEARANCE BETWEEN PISTON AND SLEEVE	0.05-0.07 (0.0019-0.0027)	-	0.05-0.07 (0.0019-0.0027)	-
PISTON PIN HOLE I.D.	22.983-22.996 (0.9048-0.9054)	23.07 (0.9083)	22.983-22.996 (0.9048-0.9054)	23.07 (0.9083)
CLEARANCE BETWEEN PISTON PIN HOLE AND PIN	0.005-0.017 (0.0002-0.0007)	-	0.005-0.017 (0.0002-0.0007)	-
PISTON PIN O.D.	22.991-23.000 (0.9052-0.9055)	22.91 (0.9020)	22.99 1-23.000 (0.9052-0.9055)	22.91 (0.9020)
<b>PISTON AND RINGS</b>				
1ST RING SIDE CLEARANCE (RING WIDTH AND RING GROOVE)	0.065-0.095 (0.0026-0.0037)	0.15 (0.0059)	0.065-0.095 (0.0026-0.0037)	0.15 (0.0059)
2ND RING SIDE CLEARANCE (RING WIDTH AND RING GROOVE)	0.03-0.065 (0.0012-0.0026)	0.15 (0.0059)	0.03-0.065 (0.0012-0.0026)	0.15 (0.0059)
OIL RING SIDE CLEARANCE (RING WIDTH AND RING GROOVE)	0.02-0.055 (0.0008-0.022)	0.15 (0.0059)	0.02-0.055 (0.0008-0.022)	0.15 (0.0059)
<b>PISTON RING</b>				
1 <sup>ST</sup> RING	3.6-3.8 (0.1417-0.1496)	3.37 (0.1327)	3.6-3.8 (0.1417-0.1496)	3.37 (0.1327)
T DIMENSIONS	1.470-1.485 (0.0579-0.0585)	1.36 (0.0535)	1.970-1.985 (0.0775-0.0781)	1.86 (0.0732)
B DIMENSIONS	3.6-3.8 (0.1417-0.1496)	3.37 (0.1327)	3.6-3.8 (0.1417-0.1496)	3.37 (0.1327)
2ND RING	1.970-1.990 (0.0776-0.0783)	1.86 (0.0732)	1.970-1.990 (0.0776-0.0783)	1.86 (0.0732)
T DIMENSIONS				
B DIMENSIONS				

**Table 6-1 SERVICE STANDARDS - Continued**

<b>L100AE-D</b>			<b>L100EE-D</b>	
<b>PARTS</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>
OIL RING	2.5-2.9	2.47	2.55-2.85	2.40
T DIMENSIONS	(0.0984-0.1141)	(0.0972)	(0.1004-0.1122)	(0.0945)
B DIMENSIONS	3.970-3.990 (0.1563-0.1571)	3.86 (0.152)	3.970-3.990 (0.1563-0.1571)	3.86 (0.152)
END GAP	0.20-0.35	1.0	0.20-0.35	1.0
1 <sup>ST</sup> RING	(0.0078-0.0138)	(0.0394)	(0.0078-0.0138)	(0.0394)
2 <sup>ND</sup> RING	0.30-0.45 (0.0118-0.0177)	1.0 (0.0394)	0.30-0.45 (0.0118-0.0177)	1.0 (0.0394)
OIL RING	0.15-0.35 (1.0059-0.0138)	1.0 (0.0394)	0.15-0.35 (1.0059-0.0138))	1.0 (0.0394)
<b>CONNECTING ROD</b>				
SMALL END HOLE	23.025-23.038	23.10	23.025-23.038	23.10
I.D.	(0.9065-0.9070)	(0.9094)	(0.9065-0.9070)	(0.9094)
OIL CLEARANCE	0.028-0.044 (0.0011-0.0017)	-	0.021-0.055 (0.0008-0.0021)	-
LARGE END HOLE	40.000-40.002	40.08	40.000-40.002	40.08
I.D.	(1.5748-1.5765)	(1.5780)	(1.5748-1.5765)	(1.5780)
OIL CLEARANCE	0.033-0.062 (0.0013-0.0024)	-	0.180.077 (0.0007-0.0030)	-
<b>CRANKSHAFT AND MAIN BEARING</b>				
CRANK PIN	39.965-39.982	39.90	39.965-39.982	39.90
PIN OD.	(1.5734-1.5741)	(1.5709)	(1.5734-1.5741)	(1.5709)
OIL CLEARANCE	0.033-0.062 (0.0013-0.0024)	-	0.018-0.077 (0.0013-0.0024)	-
CRANK JOURNAL PART				
GEAR COVER SIDE	40.002-40.018	39.91	40.002-40.018	39.91
JOURNAL O.D.	(1.5749-1.5755)	(1.5713)	(1.5749-1.5755)	(1.5713)
OIL CLEARANCE	0.025-0.061 (0.0010-0.0024)	0.17 (0.0067)	0.025-0.061 (0.0010-0.0024)	0.17 (0.0067)
FLYWHEEL SIDE	40.007-40.018	-	40.007-40.018	-
JOURNAL O.D.	(1.575 1-1.5755)		(1.5751-1.5755)	
JOURNAL PART				
FLYWHEEL SIDE	39.988-40.000	-	39.988-40.000	-
BEARING I.D.	(1.5743-1.5748)		(1.5743-1.5748)	
FITTING (TIGHT FIT)	0.007-0.030 (0.0003-0.0012)	-	0.007-0.030 (0.0003-0.0012)	-
<b>CAMSHAFT</b>				
NEEDLE BEARING ON CYLIN- DER BLOCK SIDE	14.989-15.000	14.92	14.989-15.000	14.92
SHAFT O.D.	(0.5901-0.5906)	(0.5906)	(0.5901-0.5906)	(0.5906)
BEARING I.D.	15.016-15.034 (0.5912-0.5919)	-	15.016-15.034 (0.5912-0.5919)	-
OIL CLEARANCE	0.016-0.045 (0.0006-0.00108)	-	0.016-0.045 (0.0006-0.0018)	-
BALL BEARING O.D. CRANK- CASE COVER SIDE	34.980-34.993	34.90	34.980-34.993	34.90

**Table 6-1 SERVICE STANDARDS - Continued**

<b>L100AE-D</b>			<b>L100EE-D</b>	
<b>PARTS</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>
STEM O.D.	(1.3772-1.1777)	(1.3740)	(1.3772-1.1777)	(1.3740)
BEARING O.D.	34.990-35.000 (1.3776-1.1780)	35.02 (1.3787)	35.020 (1.3787-1.3796)	35.02 (1.3787)
OIL CLEARANCE L: LOOSE FIT-T: TIGHT FIT	L 0.020-0.030 T (0.008-0.0012)	0.08-0.10 (0.0031-0.0039)	L 0.027-0.061 T (0.016-0.0110)	-
THRUST CLEARANCE (GAP OF AXIAL DIRECTION)	0.040-0.280 (0.0016-0.0110)	0.45 (0.0177)	0.040-0.280 (0.0016-0.0110)	0.45 (0.0177)
<b>TAPPET</b>				
TAPPETS FOR IN/EX VALVES STEM O.D.	6.960-6.980 (0.2740-0.2748)	6.87 (0.2705)	6.960-6.980 (0.2740-0.2748)	6.87 (0.2705)
HOLE DIA. (CYLINDER BLOCK)	7.000-7.015 (0.2756-0.2762)	7.06 (0.2780)	7.000-7.015 (0.2756-0.2762)	7.06 (0.2780)
OIL CLEARANCE	0.020-0.055 (0.008-0.0022)	-	0.020-0.055 (0.008-0.0022)	-
TAPPETS FOR FUEL INJECTION PUMP. O.D.	23.972-23.993 (0.9438-0.9446)	23.89 (0.9472)	23.972-23.993 (0.9438-0.9446)	23.89 (0.9472)
HOLE DIA. (CYLINDER BLOCK)	24.000-24.033 (0.9449-0.9462)	24.06 (0.9472)	24.000-24.033 (0.9449-0.9462)	24.06 (0.9472)
OIL CLEARANCE	0.007-0.061 (0.0003-0.0024)	-	0.007-0.061 (0.0003-0.0024)	-
<b>CRANKCASE COVER</b>				
CRANKSHAFT BEARING PART I.D.	44.000-44.025 (1.7323-1.7333)	-	44.000-44.025 (1.7323-1.7333)	-
BEARING O.D. (PLAIN)	44.085-44.120 (1.7356-1.7370)	-	44.085-44.120 (1.7356-1.7370)	-
FITTING (TIGHT FIT)	0.060-0.120 (0.0024-0.0047)	-	0.060-0.120 (0.0024-0.0047)	-
BEARING METAL I.D. (PLAIN METAL)	40 (1.5748)	40.13 (1.5800)	40.063-40.043 (1.5773-1.5765)	40.13 (1.5800)
CAMSHAFT BEARING PART I.D.	71.935-71.955 (2.8321-2.8329)	-	71.935-71.955 (2.8321-2.8329)	-
BALL BEARING O.D.	71.987-72.000 (2.8341-2.8346)	-	71.987-72.000 (2.8341-2.8346)	-
FITTING (TIGHT FIT)	0.032-0.065 (0.0013-0.0026)	-	0.032-0.065 (0.0013-0.0026)	-
<b>CYLINDER BLOCK</b>				
CRANKSHAFT BEARING PART I.D.	89.984-90.000 (3.5724-3.5433)	-	89.984-90.000 (3.5724-3.5433)	-
BALL BEARING O.D. (TIGHT FIT)	89.985-90.000 (3.5724-3.5433)	-	89.985-90.000 (3.5724-3.5433)	-
FITTING	0.015-0.016 (0.0005-0.0006)	-	0.015-0.016 (0.0005-0.0006)	-
CAMSHAFT BEARING PART I.D.	20.957-20.978 (0.8251-0.8259)	-	20.957-20.978 (0.8251-0.8259)	-

**Table 6-1 SERVICE STANDARDS - Continued**

<b>L100AE-D</b>			<b>L100EE-D</b>	
<b>PARTS</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>	<b>STANDARD</b>	<b>SERVICE LIMIT</b>
CYLINDER SLEEVE I.D.	86.000-86.030 (3.3858-3.3870)	86.18 (3.3929)	86.000-86.030 (3.3858-3.3870)	86.18 (3.3929)
<b>OIL PUMP (TROCHOID PUMP)</b>				
OUTER ROTOR O.D.	28.96-28.98 (1.1402-1.1409)	28.90 (1.1378)	44.000-44.025 (1.7323-1.7333)	-
HOUSING I.D. (CRANKCASE COVER)	29.100-29.121 (1.1457-1.1465)	29.18 (1.1488)	44.085-44.120 (1.7356-1.7370)	-
CLEARANCE BETWEEN HOUS- ING I.D. AND OUTER ROTOR O.D.	0.120-0.161 (0.0047-0.0063)	-	0.060-0.120 (0.0024-0.0047)	-
WIDTH OUTER & INNER WIDTH	7.97-8.00 (0.3138-0.3150)	7.90 (0.3150)	40.063-40.043 (1.5773-1.5765)	40.13 (1.5800)
HOUSING DEPTH	8.02-8.05 (0.3157-0.3169)	8.10 (0.3189)	71.935-71.955 (2.8321-2.8329)	-
CLEARANCE BETWEEN HOUS- ING & INNER/OUTER ROTORS	0.02-0.08 (0.0008-0.0031)	-	71.987-72.000 (2.8341-2.8346)	-
CLEARANCE BETWEEN INNER & OUER ROTOR	<0.14 (0.0055)	0.25 (0.0098)	0.032-0.065 (0.0013-0.0026)	-
CYLINDER COMPRESSION AT 500 RPM ENGINE SPEED (PULL THE RECOIL STARTER)	2452 KPA (KGF/CM <sup>2</sup> ) (356 PSI)	1961 KPA (20 KGF/CM)	0.032-0.065 (0.0013-0.0026)	-

**Table 6-2 TIGHTENING TORQUES**

<b>STANDARD BOLTS AND NUTS TIGHTENING TORQUE:</b>			
<b>M6</b>	<b>70-100 kg-cm (5.1-7.2 lb-ft)</b>		
<b>M8</b>	<b>180-200 kg-cm (13-14.5 lb-ft)</b>		
<b>WHERE SPECIFIED TORQUE BE APPLIED</b>	<b>THREAD NO. DIA.X PITCH</b>	<b>TIGHTENING TORQUE KG-CM (LB-FT)</b>	<b>REMARKS</b>
VALVE ROCKER ARM SUPPORT	M10 X 1.5	430-470 (31.1-34.0)	HEXAGONAL DIMEN- SION: 14
FLYWHEEL END NUTS*	M18 X 1.5	2200-2300 (159.1-166.3)	
CRANKCASE COVER BOLTS	13-M8 X 1.25	200-230 (14.5-16.6)	HEXAGONAL DIMEN- SION: 12
STIFFENER BOLTS ON CRANKCASE COVER	M8 X 1.25	200-230 (14.5-16.6)	
HEAD STUD BOLTS (STUD SIDE)•	4-M10 X 1.5	130-150 (9.4-10.8)	APPLY SCREW LOCKING AGENT
CYLINDER HEAD NUTS*	4-M10 X 1.5	540-580 (39.0-42.0)	HEXAGONAL DIMEN- SION: 17
FO NOZZLE CASE NUT	1-0.605-40UNS-2B	400-450 (28.9-32.5)	HEXAGONAL DIMEN- SION: 15
FO PUMP DELIVERY HOLDER	M14 X 1.5	300-350 (21.7-25.3)	HEXAGONAL DIMEN- SION: 17
FO PUMP STUD BOLTS (STUD SIDE)•	3-MG X 1.0	70-100 (5.1-7.2)	APPLY SCREW LOCKING AGENT

**Table 6-2** TIGHTENING TORQUES - Continued

<b>STANDARD BOLTS AND NUTS TIGHTENING TORQUE:</b>			
<b>M6</b>	<b>70-100 kg-cm (5.1-7.2 lb-ft)</b>		
<b>M8</b>	<b>180-200 kg-cm (13-14.5 lb-ft)</b>		
<b>WHERE SPECIFIED TORQUE BE APPLIED</b>	<b>THREAD NO. DIA.X PITCH</b>	<b>TIGHTENING TORQUE KG-CM (LB-FT)</b>	<b>REMARKS</b>
FO PUMP NUTS	3-M6 X 1.0	100-120 (7.2-8.7)	HEXAGONAL DIMEN- SION: 10
FO NOZZLE BOLTS (STUD SIDE)•	2-MG X 1.0	70-100 (5.1-7.2)	APPLY SCREW LOCKING AGENT
FO INJECTION NOZZLE NUTS	2-MG X 1.0	100-120 (7.2-8.7)	HEXAGONAL DIMEN- SION: 10
CONNECTING ROD BOLTS & NUTS*	2-M8 X 1.0	375-425 (27.1-30.7)	HEXAGONAL DIMEN- SION: 13



## CHAPTER 7

### PARTS LISTS

#### 7-1. INTRODUCTION.

This chapter contains the lists of parts for the P-100 (2BE10YDN) pump unit. This chapter also contains drawings which combined with the parts lists, will provide positive identification of parts and part numbers for use when ordering repair parts.

#### NOTE

P-100 PUMP UNITS ARE SUPPLIED WITH TWO ENGINE MODELS. YANMAR ENGINE MODEL L100AE-D WAS SUPPLIED PRIOR TO JANUARY 2000 (Figures 7-1 through 7-10). YANMAR ENGINE MODEL L100EE-D IS SUPPLIED AFTER JANUARY 2000 (Figures 7-11 through 7-21).

#### NOTE

L100AE-D and L100EE-D ENGINES ARE SUPPLIED WITH TWO RECOIL START ASSEMBLIES, TO IDENTIFY THE CORRECT ASSEMBLY YOU WILL NEED TO KNOW THE ENGINE SERIAL NUMBER. SEE FIGURE 7-18.

ENGINES WITH SERIAL NUMBERS PRECEDING 01084 REFER TO RECOIL ROPE ASSEMBLY REF. NO. 11.

ENGINES WITH SERIAL NUMBER 01084 AND LATER REFER TO RECOIL ROPE ASSEMBLY 11-1.

#### NOTE

MODIFICATIONS HAVE BEEN MADE TO THE P-100 PUMP. EARLIER VERSIONS OF THE PUMP REFER TO FIGURE 7-1. FIGURE 7-12 REFERS TO THE MODIFIED P100 PUMP. FIGURE 7-12 SHOWS A STIFFENING BRACKET BETWEEN THE DISCHARGE HEAD

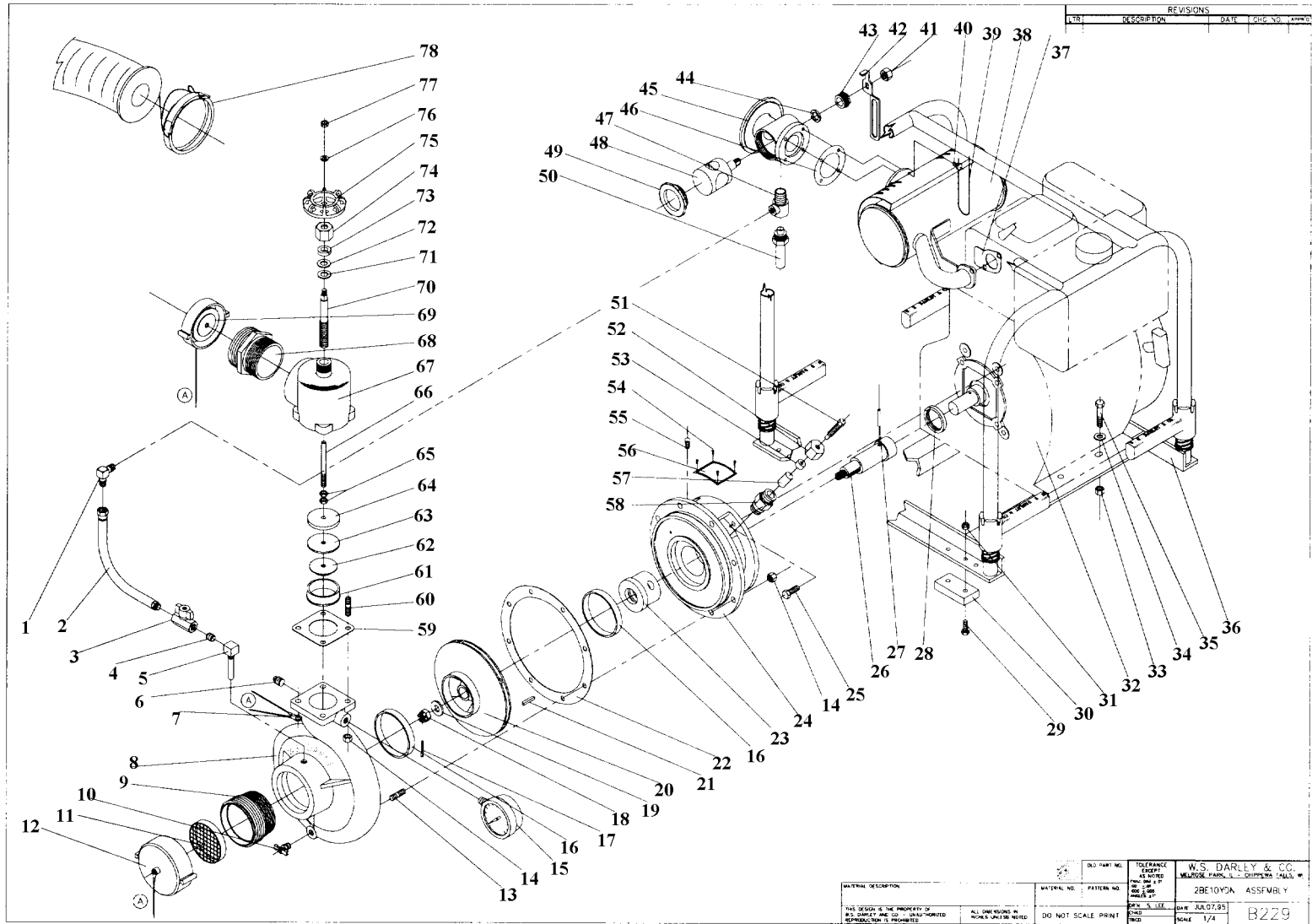


Figure 7-1 PUMP UNIT EXPLODED VIEW (DRAWING B229)



**Table 7-1** 2BE10YDN MATERIAL LIST (Reference Drawing B229)

REP NO.	NAME OF PART	QTY	PART NO.	PART NO.	MATERIAL	STANDARDS
1	ADAPTER - 1/4 NPT X 3/8 TUBE X 90	1	PA1707	3501505	360 BRASS	ASTM B16
2	PRIMER HOSE	1	G2566	4402314	PARKER HI-TEMP 836-6	SAE J516, J517
3	SHUT OFF VALVE	1	PA162	5200600	NICKEL PLATED FORGED BRASS	
4	CLOSE NIPPLE - 1/4 NPT	1	Z70000818002	1081005	360 BRASS	ASTM B16
5	PRIMER SUCTION FITTING	1	G2567	4417201	360 BRASS	ASTM B16
6	PIPE PLUG	1	Z71000818002	1080504	360 BRASS	ASTM B16
7	LANYARD	2	G2598	4421500		
8	PUMP CASING	1	B96-6	2050807	AL 319	ASTM SC64D MIL-A-8625F
9	SUCTION ADAPTER	1	B234	1603600	BRONZE SAE 660	ASTM B505 MIL-B-16261-2
10	1/4" DRAIN COCK	1	PA167	5203600	360 HEX BRASS	ASTM B16
11	HYDRANT STRAINER	1	G587-87	1121387	360 BRASS	ASTM B16
12	THREAD PROTECTOR	1	PA1320	1001600	H.I. STYRENE	ASTM D 638
13	S.S. STUD 3/8NC X 1 1/4LG.	8	G1889-11	3606202	18-8 STAINLESS STEEL	ASTM A167, A240
14	S.S. HEX NUTS 3/8 NC	12	Z20001216003	5403003	18-8 STAINLESS STEEL	ASTM A167, A240
15	DISCHARGE PRESSURE GAUGE	1	PA1221	2603026	2 1/2" LIQUID FILLED	
16	STATIONARY SEAL RING	2	B228	3407000	BRONZE SAE 660	ASTM B505 MIL-B-16261-2
17	S.S. COTTER KEY 3/32 X 3/4LG.	1	Z60000300063	3605201	18-8 STAINLESS STEEL	ASTM A167, A240
18	IMPELLER NUT	1	G1560	5403434	18-8 STAINLESS STEEL	ASTM A167, A240
19	IMPELLER WASHER	1	J46-4	3603319	303 STAINLESS STEEL	ASTM A581
20	IMPELLER	1	B226	2907300	BRONZE 85-5-5-5	ASTM 62-82
21	IMPELLER KEY	1	G2387-5	3602405	316 STAINLESS STEEL	ASTM A276
22	PUMP CASING GASKET	1	B99	3801800	CLOTH INSERTED NATURAL RUBBER	ASTM D2000-4AA515A13B13
23	STUFFING BOX	1	B227	2156400	BRONZE SAE 660	ASTM B505 MIL-B-16261-2
24	INBOARD HEAD	1	B219-3	2801203	AL319	ASTM SC64D MIL-A-8625F
25	S.S. HEX HEAD CAP SCREW M8 X 1.25 X 25MM	4	PA1617	5400305	18-8 STAINLESS STEEL	ASTM A167, A240
26	IMPELLER SHAFT	1	B102-4	5000904	316 STAINLESS STEEL	ASTM A276
27	S.S. RETAINING PIN - SPRING PIN 3/16 X 1 1/2	1	Z40000600123	3605024	18-8 STAINLESS STEEL	ASTM A167, A240
28	OIL SEAL	1	G1194-57	3600557	CLIPPER 0150-09831	
29	S.S. HEX HEAD CAP SCREW 5/16NC X 7/8 LG.	8	Z10001018073	5400640	18-8 STAINLESS STEEL	ASTM A167, A240

**Table 7-1** 2BE10YDN MATERIAL LIST (Reference Drawing B229) - Continued

REP NO.	NAME OF PART	QTY	PART NO.	PART NO.	MATERIAL	STANDARDS
30	MOUNTING PAD	4	G2553	4021300	MOLDED HARDCAST 116 PLASTIC	ASTM D638, D648, D790
31	S.S. HEX NYLOC NUTS 5/16 NC	8	PA1301	5403400	18-8 STAINLESS STEEL	ASTM A167, A240
32	DIESEL ENGINE	1		4214307	YANMAR L100AE	
33	S.S. HEX NUTS 3/8 NC	4	Z20001216003	5403003	18-8 STAINLESS STEEL	ASTM A167, A240
34	S.S. FLAT WASHER 3/8	2	Z30101200003	3603809	18-8 STAINLESS STEEL	ASTM A167, A240
35	S.S. HEX HEAD CAP SCREW 3/8NC X 1-3/4 LG.	4	Z10001216143	5400619	18-8 STAINLESS STEEL	ASTM A167, A240
36	BASE	1	B232	1683000	6061T6 ALUM TUBE & ANGLE	ASTM B241 & B210
37	EXHAUST GASKET	1	PA1321	3819700	YANMAR 114650-13200	
38	EXHAUST SILENCER	1	PA781	1220900		
39	SAFETY WIRE, .041 X 14"	2	G2590	4423600	302/304 STAINLESS STEEL	QQ-W-423B MS-20995
40	HEX BOLT, 1/4-20NC X 1.25	4	G2475-1	5400635	GRADE 8 STEEL	ASTM A354
41	LEVER NUT - TOP LOCK - S.S. 1/2 NC	1	PA1705	5403457	18-8 STAINLESS STEEL	ASTM A167, A240
42	LEVER	1	G2563	3009400	316 STAINLESS STEEL	ASTM A276
43	PACKING NUT	1	G2562	5403458	360 BRASS	ASTM B16
44	PACKING RING	2	G2565	3603913	GRAPHITE PACKING	ASTM F104 F517100B1M3
45	PRIMER BODY	1	G2559	2055700	81-3-7-9 CAST BRASS	ASTM B505-82A
46	PRIMER GASKET	1	G1808-1	3805601	S1200 CARBON FIBER	ASTM F104-F112231-M7
47	PRIMER THROAT	1	G622-6	4416806	360 BRASS	ASTM B16
48	PRIMER PLUG	1	G2560	4421600	360 BRASS	ASTM B16
49	END CAP	1	G2561	1002000	81-3-7-9 CAST BRASS	ASTM B505-82A
50	PRIMER JET	1	G620-4	4416704	81-3-7-9 CAST BRASS	ASTM B505-82A
51	PACKING SCREW	1	H176	2156200	303 STAINLESS STEEL	ASTM A581
52	GLAND NUT	1	A449	2150300	360 HEX BRASS	ASTM B16
53	GLAND STUD PISTON	1	S439	2154500	303 STAINLESS STEEL	ASTM A581
54	SCREW- DRIVE, #4 X 1/4	4	PA796	5402820	ALUMINUM	
55	S.S. SOCKET HEAD CAP SCREW 1/4NC X 3/8 LG	1	Z10100820033	5401400	18-8 STAINLESS STEEL	ASTM A167, A240
56	IDENTIFICATION TAG	1	G2577	1969000	BRASS	ASTM B36-91A
57	PACKING, PLASTALLIC GRAPHITE COMPOSITE	6	PA927	3817102	GARLOCK STYLE 926	NA
58	PACKING CYLINDER	1	B138	2150800	360 HEX BRASS	ASTM B16

**Table 7-1** 2BE10YDN MATERIAL LIST (Reference Drawing B229) - Continued

REP NO.	NAME OF PART	QTY	PART NO.	PART NO.	MATERIAL	STANDARDS
59	DISCHARGE HEAD GASKET	1	A241	3800800	CLOTH INSERTED NATURAL RUBBER	ASTM D2000-4AA515A13B13
60	S.S. STUD 3/8NC X 1 1/2LG.	4	G1889-7	3606208	18-8 STAINLESS STEEL	ASTM A167, A240
61	CHECK VALVE SEAT	1	A126-1	5260001	360 BRASS	ASTM B16
62	CHECK VALVE DIFFUSER	1	A127-3	5300003	316 STAINLESS STEEL	ASTM A276
63	CHECK VALVE RUBBER	1	A139-3	3800203	CLOTH INSERTED NATURAL RUBBER	ASTM D2000-4AA515A13B13
64	CHECK VALVE PLATE	1	A138-1SS	5280202	316 STAINLESS STEEL	ASTM A276
65	S.S. JAM NUT 5/16NF	2	Z20201024003	5403204	18-8 STAINLESS STEEL	ASTM A167, A240
66	CHECK VALVE STEM	1	A170-3	5240103	316 STAINLESS STEEL	ASTM A276
67	DISCHARGE HEAD	1	A450-3	2800506	AL 319	ASTM SC64D MIL-A-8625F
68	DISCHARGE ADAPTER	1	G313	1602400	60-0-2-38 BRASS	ASTM B124-86
69	THREAD PROTECTOR	1	PA1322	1001900	H.I. STYRENE	ASTM D 638
70	VALVE STEM	1	A120-3	5240003	360 BRASS	ASTM B16
71	DISCHARGE HEAD STUFFING BOX GASKET	1	A193	3800400	CLOTH INSERTED NATURAL RUBBER	ASTM D2000-4AA515A13B13
72	STUFFING BOX WASHER	1	A84-1	3603701	360 BRASS	ASTM B16
73	CHECK VALVE STEM PACKING 1/8" X 13"	1.08	PA928	4404000	GARLOCK STYLE 8909	NA
74	GLAND NUT	1	A62-1	2150601	360 HEX BRASS	ASTM B16
75	HAND WHEEL STYLE F	1	PA135	3001600	MALLEABLE IRON	ASTM A47
76	S.S. LOCKWASHER 5/16"	1	Z30001000003	3603530	18-8 STAINLESS STEEL	ASTM A167, A240
77	S.S. JAM NUT	1	Z20001018003	5403024	18-8 STAINLESS STEEL	ASTM A167, A240
78	EXHAUST HOSE AND CLAMP	2	PA777	4402311		
79	LOCKWASHER, M8	4	PA792	3603528	18-8 STAINLESS STEEL	ASTM A167, A240
80	S.S. HEX NUT M8	2	PA793	5403105	18-8 STAINLESS STEEL	ASTM A167, A240
81	S.S. HEX HEAD CAP SCREW M8X1.25X16MM	2	PA789	5400801	18-8 STAINLESS STEEL	ASTM A167, A240

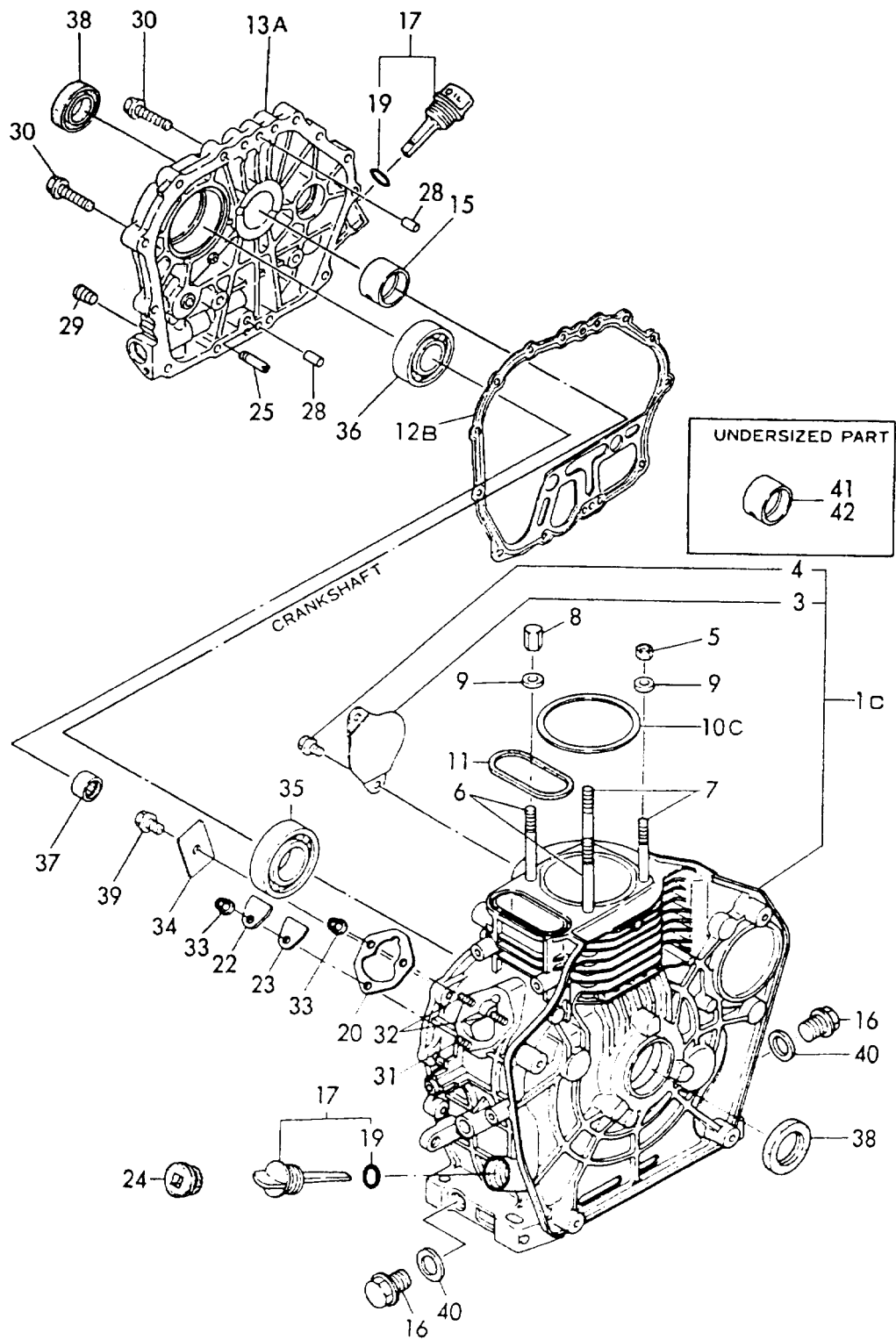


Figure 7-2 CYLINDER BLOCK

Table 7-2 CYLINDER BLOCK L100AE-D

REF NO.	PART NO.	DESCRIPTION	QTY.
1C	4214300	BLOCK ASSY, CYLINDER	1
3	114350-01700	COVER, STARTER	1
4	26106-100122	BOLT M10X 12 PLATED	2
5	105025-01220	NUT 10	2
6	114650-01230	BOLT (A)	2
7	114650-01240	BOLT (B)	2
8	114650-01250	NUT 10	2
9	114650-01260	WASHER	4
10C	114970-01340	GASKET, CYL. HEAD	1
11	114650-01380	O-RING	1
12B	114650-01412	GASKET, CRANK CASE	1
13A	4214301	COVER (D), CRANK CASE	1
15	114650-02100	BEARING, MAIN	1
16	4214302	PLUG M16	1
17	160910-01740	CAP, W/LUB.OIL GAUGE	2
19	24311-000180	O-RING 1A P-18.0	2
20	114250-01800	SHIM SET	1
22	114250-01830	COVER, INSPEC. WINDOW	1
23	114250-01841	GASKET	1
24	160110-01870	PLUG, RUBBER W/SCREW	1
25	114250-35150	PIPE, L.O. INLET	1
28	22312-080120	PARALLEL PIN 8X12	2
29	23871-010000	PLUG PT1/8, SCREW	1
30	26106-080352	BOLT M 8X 35 PLATED	16
31	26226-060182	STUD M 6X 18 PLATED	1
32	26226-060222	STUD M 6X 22 PLATED	2
33	26366-060002	NUT M 6	3
34	114250-02030	RETAINER, BEARING	1
35	114650-02150	BALL BEARING	1
36	24101-062070	BALL BEARING	1
37	24162-152112	NEEDLE BEARING	1
38	24423-355008	SEAL, OIL	2
39	26106-080122	BOLT M 8X 12 PLATTED	1
40	43400-500490	SEAL WASHER 16	1
41	114650-02200	MAIN BEARING US=0.25	1



**Table 7-2** CYLINDER BLOCK L100AE-D - Continued

REF NO.	PART NO.	DESCRIPTION	QTY.
42	114650-02210	MAIN BEARING US=0.50	1

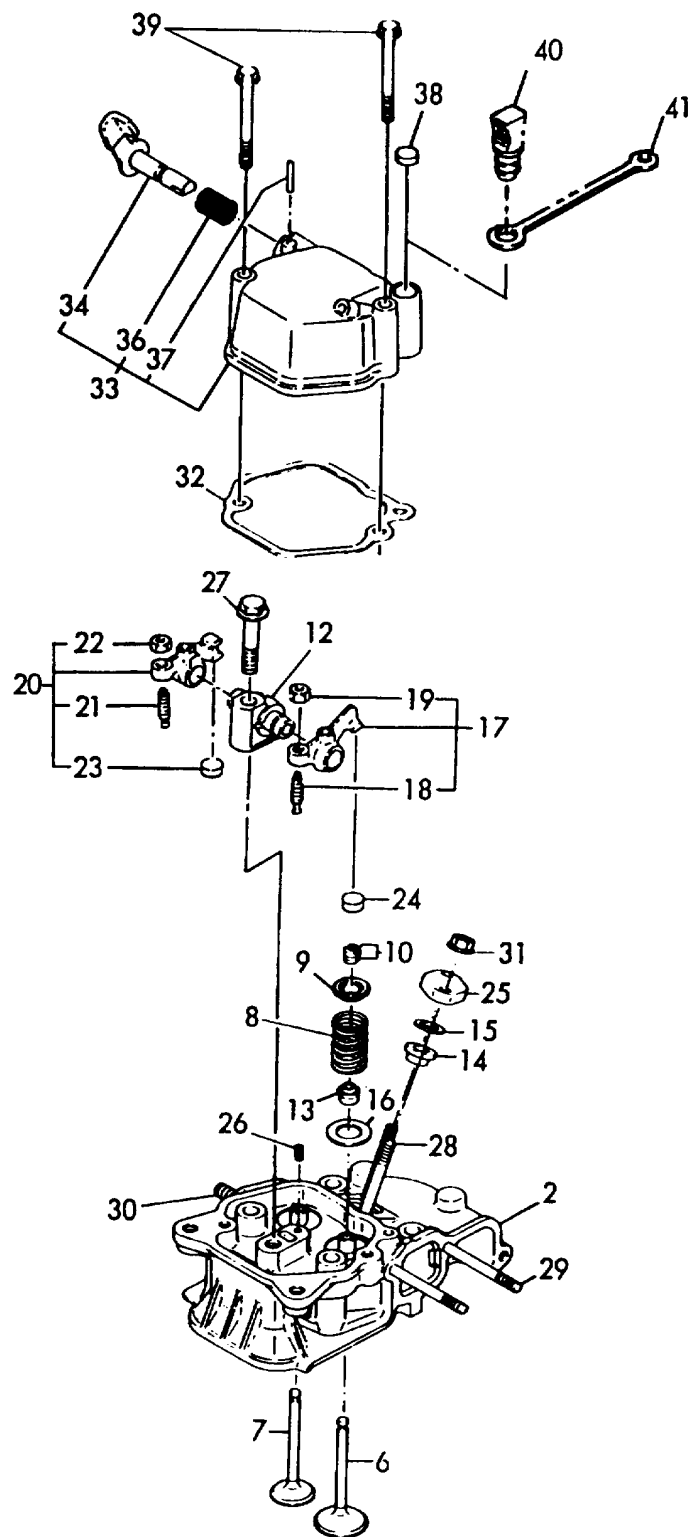


Figure 7-3 CYLINDER HEAD AND BONNET ASSEMBLY

**Table 7-3 CYLINDER HEAD & BONNET L100AE-D**

REF NO.	PART NO.	DESCRIPTION	QTY
2	4214303	HEAD ASSY, CYLINDER	1
6	114650-11100	VALVE, SUCTION	1
7	114654-11110	VALVE, EXHAUST	1
8	114650-11121	SPRING, VALVE	2
9	119620-11180	RETAINER, SPRING	2
10	27310-070001	COTTER 7	2
12	114650-11261	SUPPORT, ROCKER ARM	1
13	114650-11340	SEAL, VALVE STEM	2
14	114250-11460	GASKET, NOZZLE	1
15	114350-11470	SPACER, NOZZLE	1
16	114650-11600	WASHER	2
17	114650-11652	ARM ASSY, INTAKE	1
18	114250-11240	SCREW, VALVE ADJUST.	1
19	26756-060002	LOCK NUT M 6 PLATED	1
20	714670-11660	ARM ASSY, EXHAUST	1
21	114250-11240	SCREW, VALVE ADJUST.	1
22	26756-060002	LOCK NUT M 6 PLATED	1
23	104211-11370	CAP, VALVE	1
24	104211-11370	CAP, VALVE	1
25	114250-11900	RETAINER, NOZZLE	1
26	22351-040008	SPRING PIN 4X 8	1
27	26106-100552	BOLT M10X 55 PLATED	1
28	26226-060502	STUD M 6X 50	2
29	26226-060752	STUD M 6X 75	2
30	26226-080202	STUD M 8X 20 PLATED	2
31	26366-060002	NUT M 6	2
32	3820200	GASKET, BONNET	1
33-1	4214304	COVER, VALVE ROCKER ARM	1
34	114250-03591	LEVER, DECOMPRESSION	1
36	114250-03640	SPRING	1
37	22312-030160	PARALLEL PIN 3X 16	1
38	129100-61850	PLUG (12)	1
39	26106-060702	BOLT M 6X 70 PLATED	2
40	114250-76600	PLUNGER	1
41	114250-76610	HOLDER, PLUNGER	1

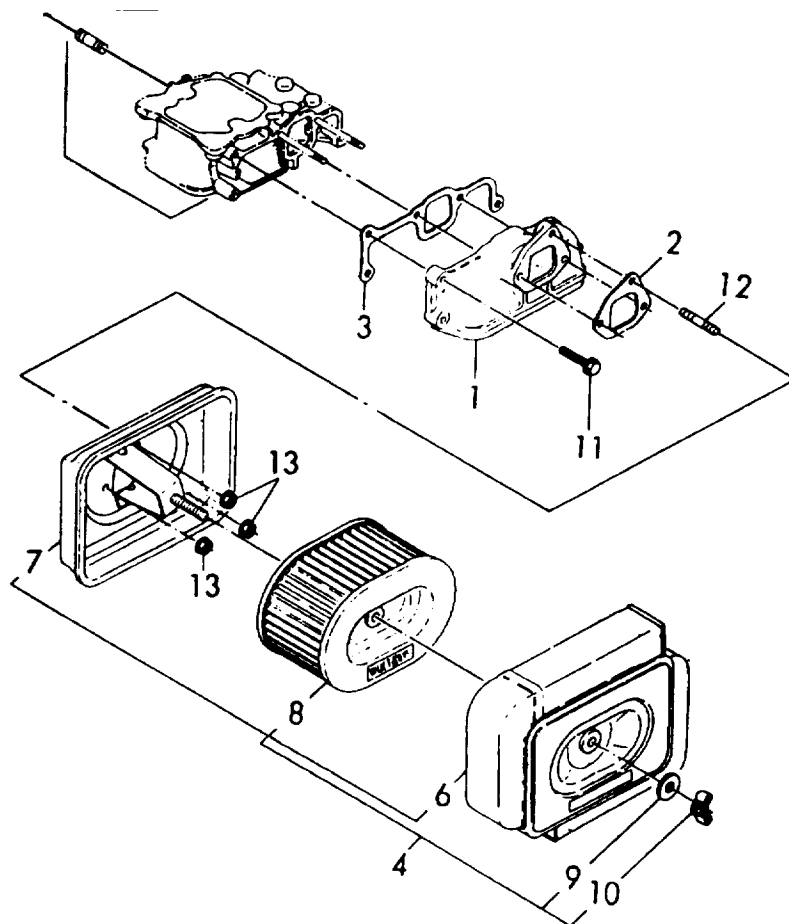


Figure 7-4 AIR CLEANER ASSEMBLY

Table 7-4 AIR CLEANER ASSEMBLY

REF NO.	PART NO.	DESCRIPTION	QTY
1	4214305	BEND, AIR INTAKE	1
2	114650-12210	GASKET, AIR CLEANER	1
3	114650-12300	GASKET, AIR INTAKE	1
4	714650-12560	CLEANER ASSY AIR	1
6	114650-12520	COVER, AIR CLEANER	1
7	114650-12530	CASE, AIR CLEANER	1
8	4209901	ELEMENT W/PRE-FILTER	1
9	114252-12560	WASHER, SEAL	1
10	5403500	WING NUT M8	1
11	26106-060252	BOLT M 6X 25 PLATED	3
12	26226-060142	BOLT M 6X 14 PLATED	1
13	26366-060002	NUT M 6	3
14	114650-13200	GASKET, MUFFLER (NOT SHOWN)	1

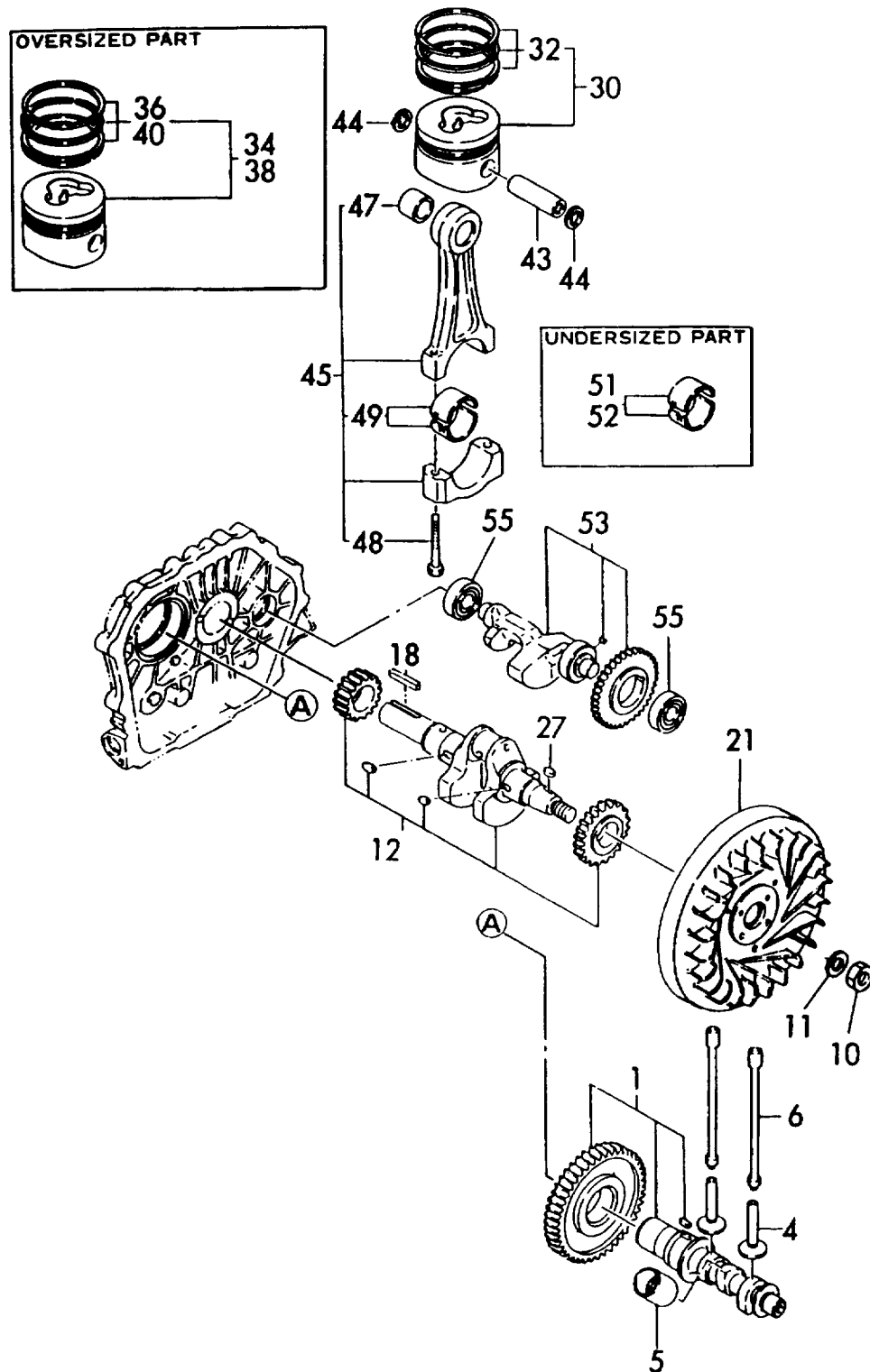


Figure 7-5 CRANKSHAFT, PISTON, AND CAMSHAFT ASSEMBLY

**Table 7-5** CAM/CRANK SHAFT & PISTON/ROD L100AE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	714689-14580	CAMSHAFT(D) ASSY.	1
4	114650-14200	TAPPET, SUC./EXH.	2
5	114250-14260	TAPPET, FUEL	1
6	114650-14401	ROD, PUSH	2
10	122710-01220	NUT (M18)	1
11	114650-21551	WASHER, FLYWHEEL	1
12	4214306	CRANKSHAFT ASSY(D/DE)	1
18	160842-21150	KEY 6.3X50	1
21	114660-21401	FLYWHEEL (D)	1
27	22512-050140	KEY 5X 14	1
30C	714980-22720	PISTON W/RINGS	1
32C	714970-22500	RING SET, PISTON	1
34C	714980-22620	PISTON WIRING (OSO.25)	1
36C	714970-22540	RING SET (OS 0.25)	1
38C	714980-22580	PISTON W/RINGS.50OS	1
40C	714970-22550	RING SET 0.S=0.5	1
43	114650-22300	PIN, PISTON	1
44	129792-22400	CIRCLIP 23	2
45	714650-23700	ROD ASSY, CONNECTING	1
47	124060-23911	BUSH, PISTON PIN	1
48	104200-23201	BOLT, ROD	2
49	714650-23600	BEARING, CRANKPIN	1
51	714650-23610	BEARING, PIN (U.S=0.25)	1
52	714650-23620	BEARING, PIN (U.S=0.50)	1
53	714970-28510	SHAFT ASSY, BALANCER	1
55	24101-062034	BALL BEARING	2

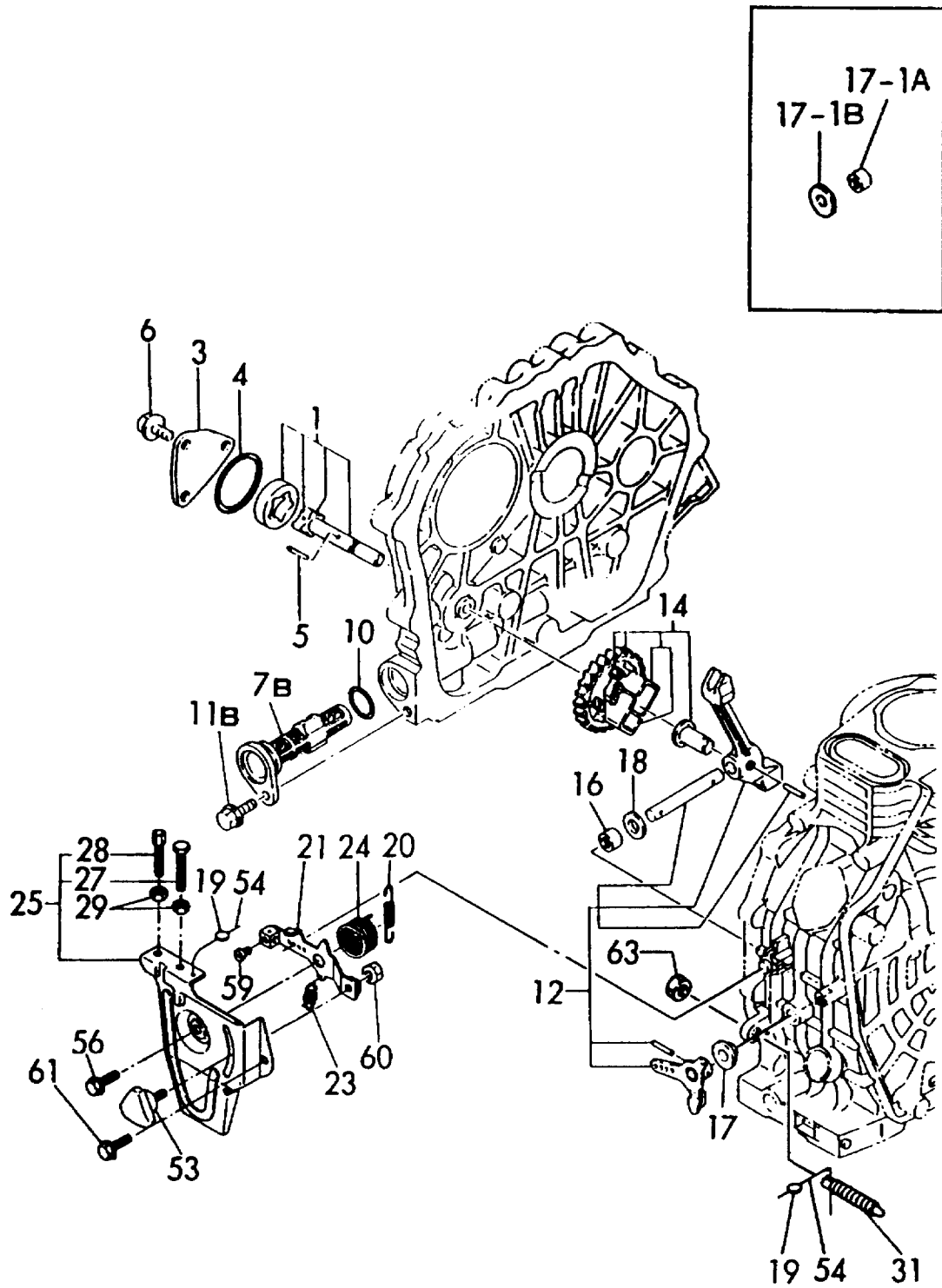


Figure 7-6 LUBRICATING OIL PUMP AND GOVERNOR

**Table 7-6 L.O. DEVICE & GOVERNOR CONTROL L100AE-D**

REF NO.	PART NO.	DESCRIPTION	QTY
1	114650-32010	PUMP ASSY, LUB. OIL	1
3	114250-32070	COVER, LUB. OIL PUMP	1
4	103338-32570	O-RING	1
5	22312-030160	PARALLEL PIN 3X16	1
6	26476-060142	BOLT M 6X 14, TAPPING	3
7B	114250-35070	STRAINER, LUB. OIL	1
10	24341-000224	O-RING 1A S-22.4	1
11B	5400804	BOLT M 6X 16 (18-8SS)	1
12	714650-61500	LEVER ASSY, GOVERNOR	1
14	714970-61700	GOVERNOR ASSY	1
16	121450-61520	NEEDLE BEARING FJ810	2
17-1A	114770-61600	BUSH, THRUST	1
17-1B	114770-61610	BUSHING	1
18	22137-080000	WASHER 8, POLISHED	1
19	135210-61090	LEAD	2
20	114970-66010	SPRING, REGULATOR	1
21	114250-66050	HANDLE, REGULATOR	1
23	114250-66200	SPRING, RETURN	1
24	114252-66252	SPRING, RETURN	1
25	714268-66500	BRACKET ASSY, REGULAT	i
27	114250-66440	BOLT, ADJUSTING	1
28	102100-67080	BOLT, ADJUSTING	1
29	26757-060002	LOCK NUT M 6 PLATED	2
31	114650-66500	TORQUE SPRING ASSY	1
53	160725-78350	BOLT (W/M6X15)	1
54	22451-060000	WIRE 0.6	2
56	5400804	BOLT M 6X 16 (18-8SS)	1
59	26116-040088	BOLT M 4X 8 PLATED	1
60	26346-060002	U-NUT M 6 PLATED	1
61	5400804	BOLT M 6X 16 (18-8SS)	1
63	26696-100002	NUT M10	1
	3603808	WASHER, FLAT M 6 (18-8SS)	3



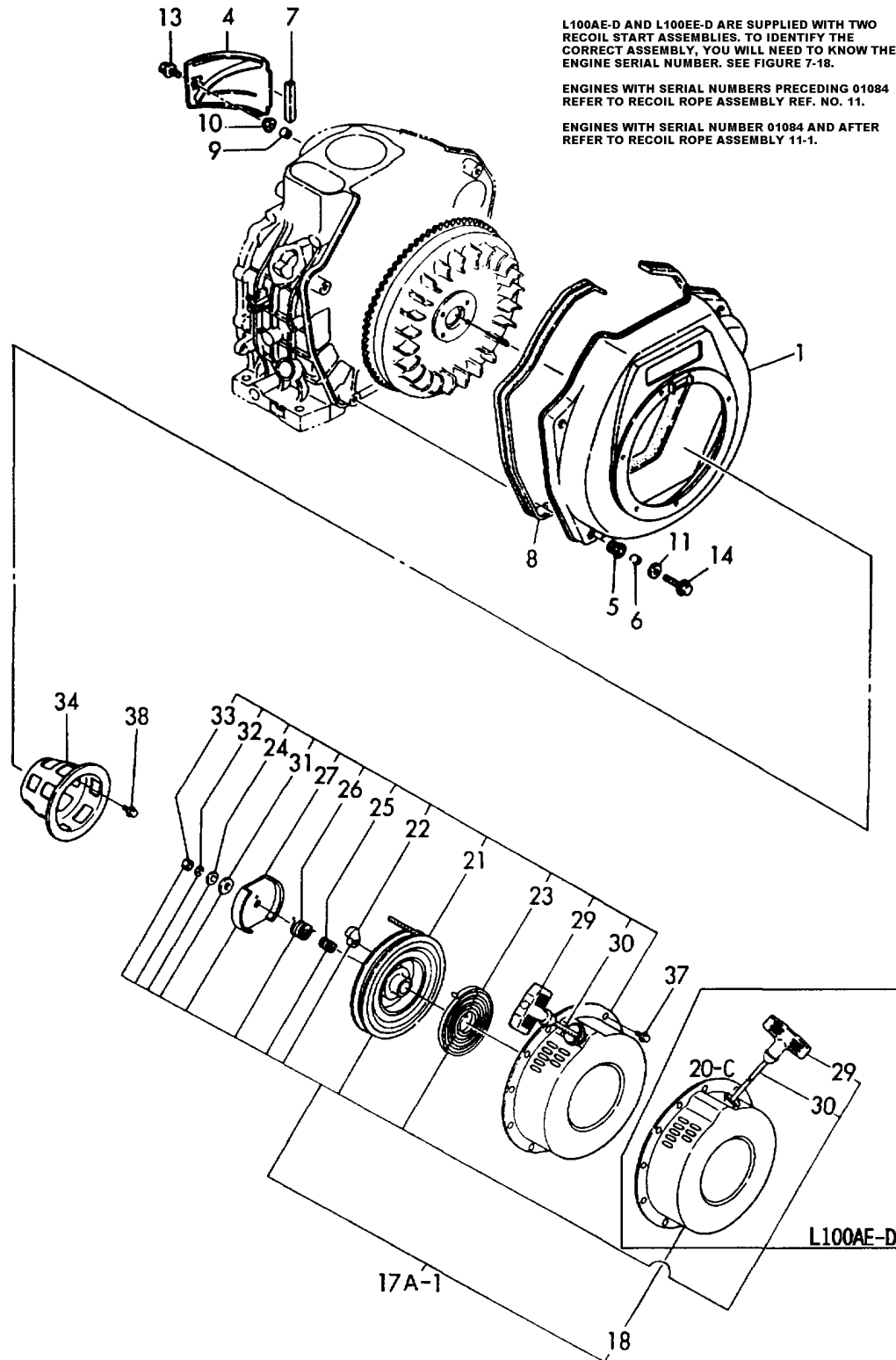


Figure 7-7 COOLING AND STARTING DEVICE

**Table 7-7** COOLING & STARTING DEVICE L100AE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	114668-45102	CASE(D), COOLING FAN	1
4	114650-45200	COVER, CYLINDER	1
5	114250-45300	SHOCK ABSORBER	4
6	114250-45310	COLLAR	4
7	114350-45320	RUBBER, SEAL	1
8	114650-45330	SEAL, FAN CASE	1
9	114350-45340	COLLAR	1
10	183720-55210	GROMMET	1
11	3603808	WASHER M6 (18-8SS)	9
13	5400800	BOLT M 6X 18, (18-8SS)	1
14	5400805	BOLT M 6X 25, 18-8SS)	4
17A-1	714660-76821	RECOIL STARTER(D) ASY	1
18	714660-76831	CASE (D) W/LABEL	1
20C	114250-07350	LABEL, YANMAR DIESEL	1
21	114650-76520	REEL, RECOIL	1
22	160910-76530	RATCHET	1
23	114650-76540	SPRING, SPIRAL	1
24	160910-76550	WASHER, THRUST	1
25	160910-76560	SPRING, FRICTION	1
26	160910-76570	SPRING, RETURN	1
27	160910-76580	PLATE, FRICTION	1
29	160910-76620	KNOB, STARTER	1
30	114650-76630	ROPE, RECOIL STARTER	1
31	160910-76650	WASHER (B)	1
32	22217-060000	SPRING WASHER 6	1
33	26716-060002	NUT M 6	1
34	114660-76590	PULLEY, STARTER	1
37	26106-060082	BOLT M 6X 8 PLATED	4
38	26106-060122	BOLT M 6X 12 PLATED	3

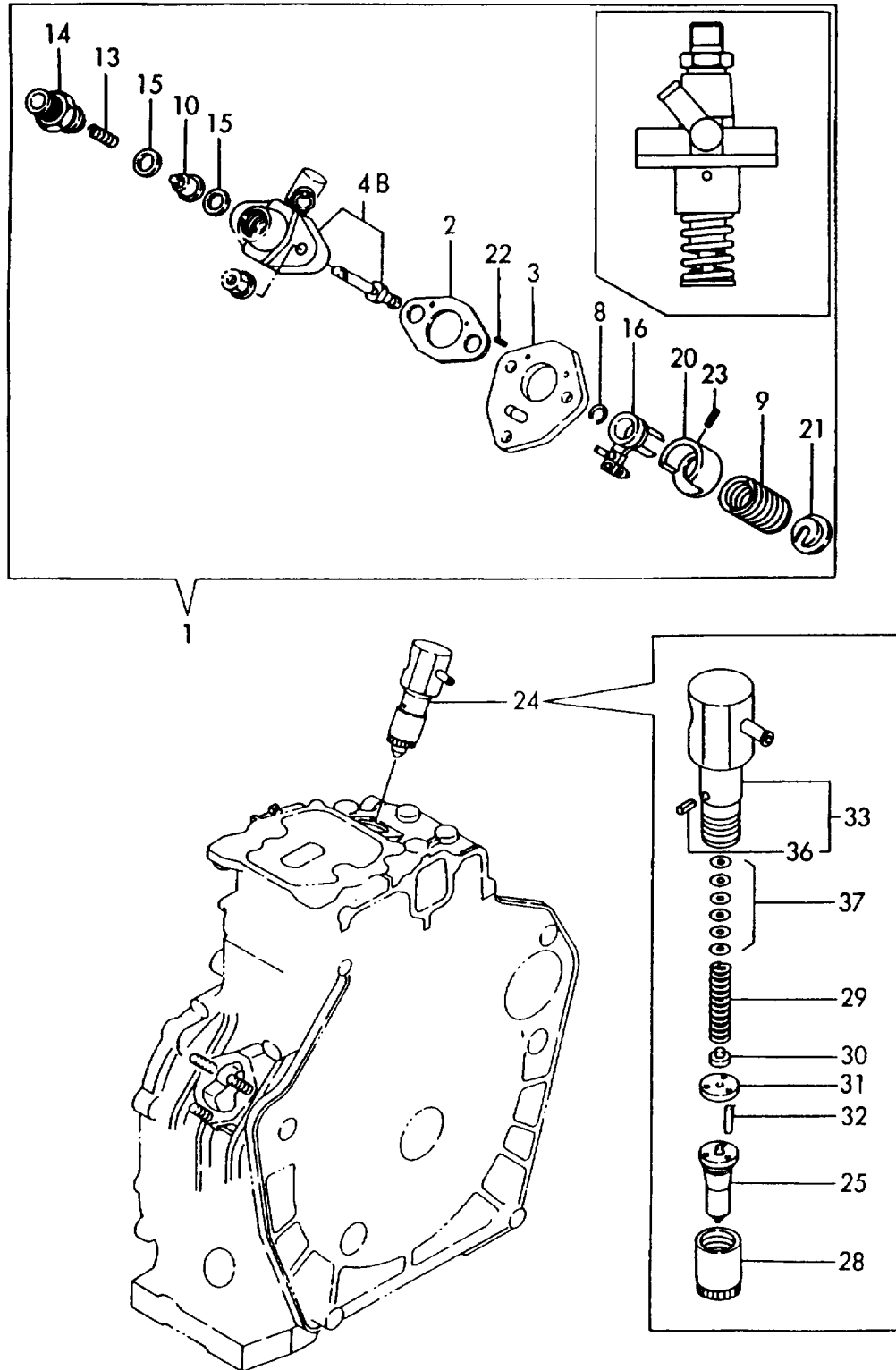


Figure 7-8 FUEL INJECTION PUMP AND VALVE

**Table 7-8 FUEL INJECTION PUMP & VALVE L100AE-D**

REF NO.	PART NO.	DESCRIPTION	QTY
1C	714970-51700	PUMP ASSY, F. INJECT.	1
2	105546-51020	GASKET	1
3	114250-51080	PLATE	1
4B	114970-51100	BODY, F. I. PUMP	1
8	114250-51150	SNAP RING	1
9	114250-51160	SPRING	1
10	114650-51300	VALVE ASSY, DELIVERY	1
13	105546-51330	SPRING, DELIV. VALVE	1
14	114250-51340	HOLDER, F.I.P. DELIVERY	1
15	124550-51350	GASKET, DELIVERY	2
16	114250-51600	LEVER ASSY, CONTROL	1
20	114250-51640	SEAT (A), SPRING	1
21	114250-51650	SEAT (B), SPRING	1
22	22351-020006	SPRING PIN 2X 6	2
23	22351-030008	SPRING PIN 3X 8	1
24	714650-53100	VALVE ASSY, F. INJECT.	1
25	114650-53000	NOZZLE ASSY, F. INJECT.	1
28	114250-53080	NUT, NOZZLE CASE	1
29	114250-53120	SPRING, NOZZLE	1
30	114250-53130	RETAINER, SPRING	1
31	114250-53140	PLATE, STOP	1
32	114250-53210	PIN	2
33	114650-53300	HOLDER ASSY, NOZZLE	1
36	114250-53331	PIN, SPRING	1
37	114250-53400	SHIM PACK	1

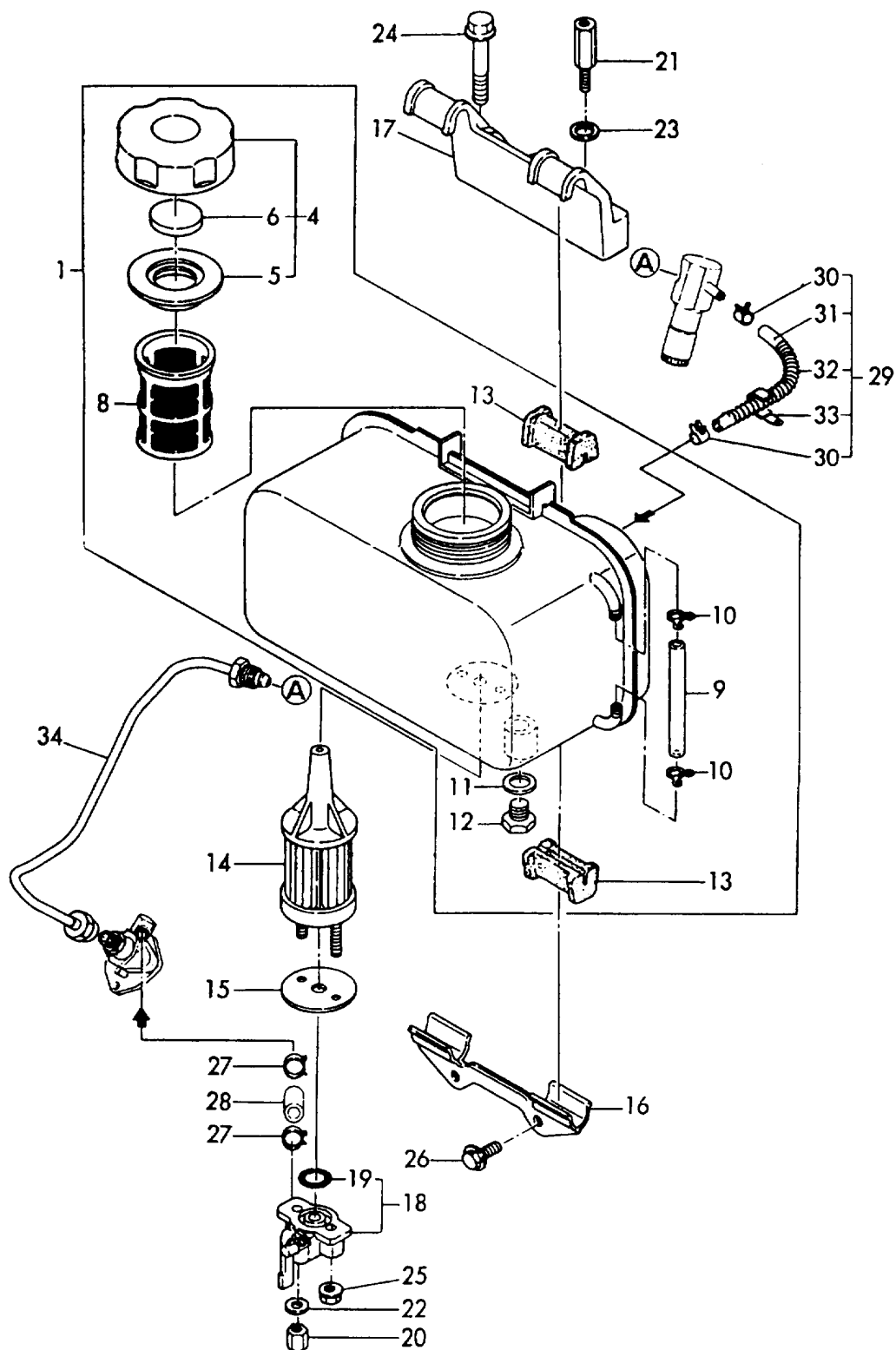


Figure 7-9 FUEL TANK AND FUEL LINE

**Table 7-9 FUEL TANK & FUEL PIPE L100AE-D**

REF NO.	PART NO.	DESCRIPTION	QTY
1	714569-55701	TANK ASSY, FUEL (D/S)	1
4	114250-55041	CAP, TANK	1
5	114250-55050	GASKET, TANK CAP	1
6	114250-55060	SEAL	1
8	114250-55100	STRAINER, FUEL	1
9	114650-55150	HOSE, GAUGE	1
10	124722-59050	CLAMP 9	2
11	23414-120000	GASKET 12, ROUND	1
12	23887-120002	PLUG 12, HEX.	1
13	114250-55201	DAMPER, FUEL TANK	4
14	114650-55120	FILTER, FUEL OIL	1
15	114250-55130	GASKET	1
16	114250-55211	STAY (A)	1
17	114650-55230	STAY (B)	1
18	114250-55300	COCK ASSY, FUEL	1
19	24341-000150	O-RING 1A S-15.0	1
22	22117-060000	WASHER 6	1
23	3603807	WASHER 8 (18-8SS)	2
24	5400803	BOLT M 8X 45 (18-8SS)	2
25	5403103	NUT M 6 (18-8SS)	2
26	26476-060142	BOLT M 6X 14, TAPPING	2
27/30	4402606	CLAMP, HOSE	4
28	114250-59050	PIPE, FUEL OIL	1
29	114652-59300	PIPE, FUEL RETURN	1
31	114250-59060	PIPE, FUEL RETURN	1
32	114652-59310	TUBE, PROTECT	1
33	121750-59890	RETAINER	1
34	114650-59800	PIPE, FUEL INJECTION	1

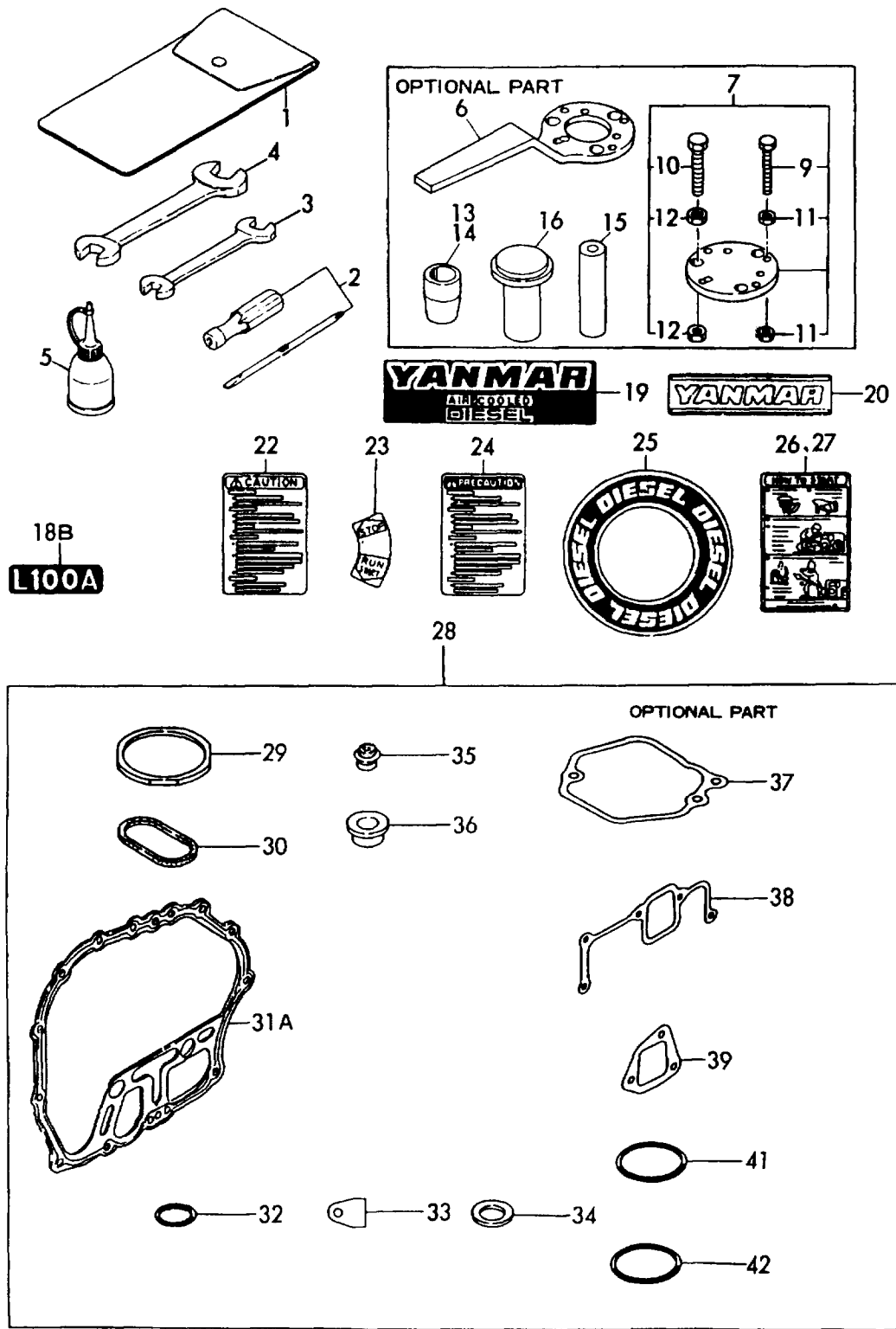


Figure 7-10 LABEL, TOOL, AND GASKET SET

**Table 7-10** LABEL, TOOL, & GASKET SET L100AE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	114250-92600	BAG, TOOL	1
2	160330-92730	SCREWDRIVER	1
3	28110-100120	WRENCH 10X12	1
4	28110-140170	WRENCH 14X17	1
5	28210-000150	FEEDER, OIL	1
6	114250-92101	F.W. LOCKING HANDLE	1
7	114250-92130	REMOVER, FLYWHEEL	1
9	26116-060504	BOLT M 6X 45 PLATED	4
10	26116-080454	BOLT M 8X 45 PLATED	3
11	26716-060002	NUT M 6	8
12	26716-080002	NUT M 8	6
13	114668-92300	GUIDE, OIL SEAL	1
15	114650-92310	INSTALLING TOOL	1
16	114650-92350	INSTALLING TOOL	1
18B	114970-07050	LABEL, (L100A)	1
19	114250-07090	LABEL, AIR COOLED	1
20A	114250-07110	LABEL, YANMAR	1
20B	183250-07110	LABEL, YANMAR	1
22	114268-07240	LABEL, CAUTION	1
23	114250-07260	LABEL, OPERATION	1
24	114268-07280	LABEL, PRECAUTION	1
25	114250-07350	LABEL, YANMAR DIESEL	1
26	114268-07350	LABEL, HOW TO START	1
27	114268-07360	LABEL, HOW TO START (F	1
28C	714970-92600	GASKET SET	1
29C	114970-01340	GASKET, CYL. HEAD	1
30	114650-01380	O-RING	1
31A	114650-01412	GASKET, CRANK CASE	1
32	24311-000180	O-RING 1A P-18.0	2
33	114250-01841	GASKET	1
34	43400-500490	SEAL WASHER 16	2
35	114650-11340	SEAL, VALVE STEM	2
36	114250-11460	GASKET, NOZZLE	1
37	114650-11310	GASKET, BONNET	1
38	114650-12300	GASKET, AIR INTAKE	1
39	114650-12210	GASKET, AIR CLEANER	1
41	103338-32570	O-RING	1
42	24341-000224	O-RING, L.O. STRAINER	1



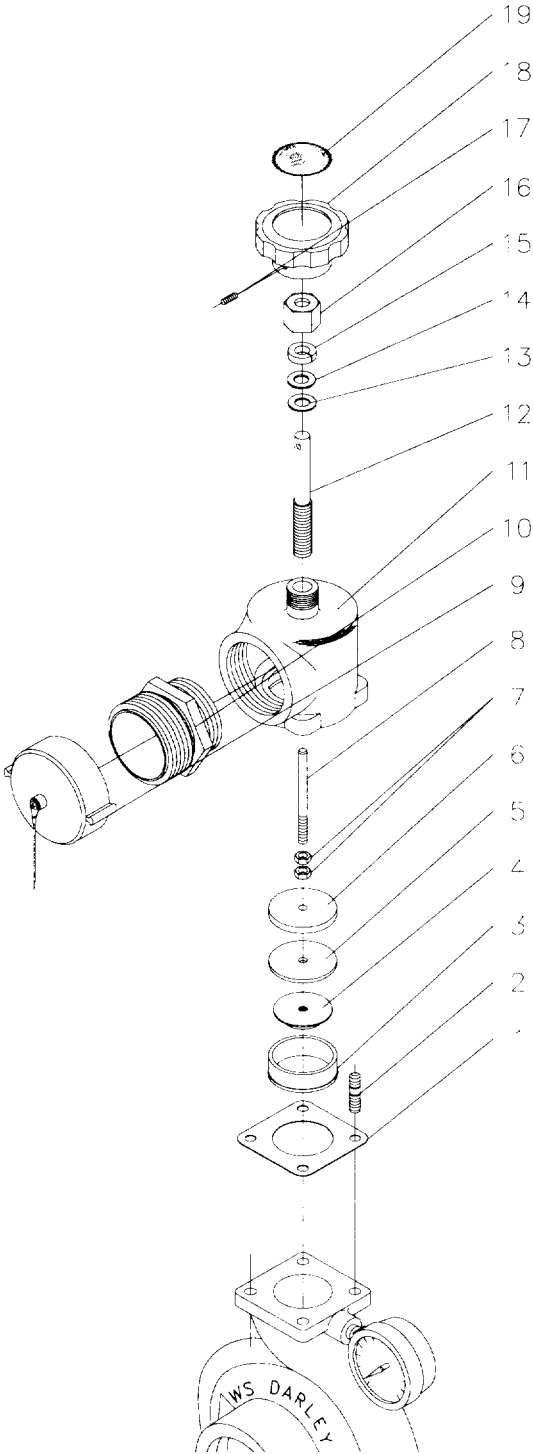


Figure 7-11 NEW PUMP DISCHARGE HEAD

**Table 7-11** NEW PUMP DISCHARGE HEAD

REF NO.	PART NO.	DESCRIPTION	QTY
—	HA00213	DISCHARGE HEAD ASSEMBLY	1
1	3800800	DISCHARGE HEAD GASKET	1
2	3606208	S.S. STUD 3/8NC X 1 1/2 LG.	4
3	5260001	CHECK VALVE SEAT	1
4	5300003	CHECK VALVE DIFFUSER	1
5	3800203	CHECK VALVE RUBBER	1
6	5280202	CHECK VALVE PLATE	1
7	5403204	S.S. JAM NUT 5/16NF	2
8	5240103	CHECK VALVE STEM	1
9	1001900	THREAD PROTECTOR	1
10	1602400	DISCHARGE ADAPTER	1
11	2800509	DISCHARGE HEAD	1
12	5240005	VALVE STEM	1
13	3800400	DISCHARGE HEAD STUFFING BOX GASKET	1
14	3603701	STUFFING BOX WASHER	1
15	4404000	CHECK VALVE STEM PACKING 1/8" X 13"	1.08
16	2150601	GLAND NUT	1
17	5402603	SOCKET SET SCREW, .25-20 NC	1
18	3001800	HANDWHEEL	1
19	1962102	DECAL - OPEN/CLOSE	1

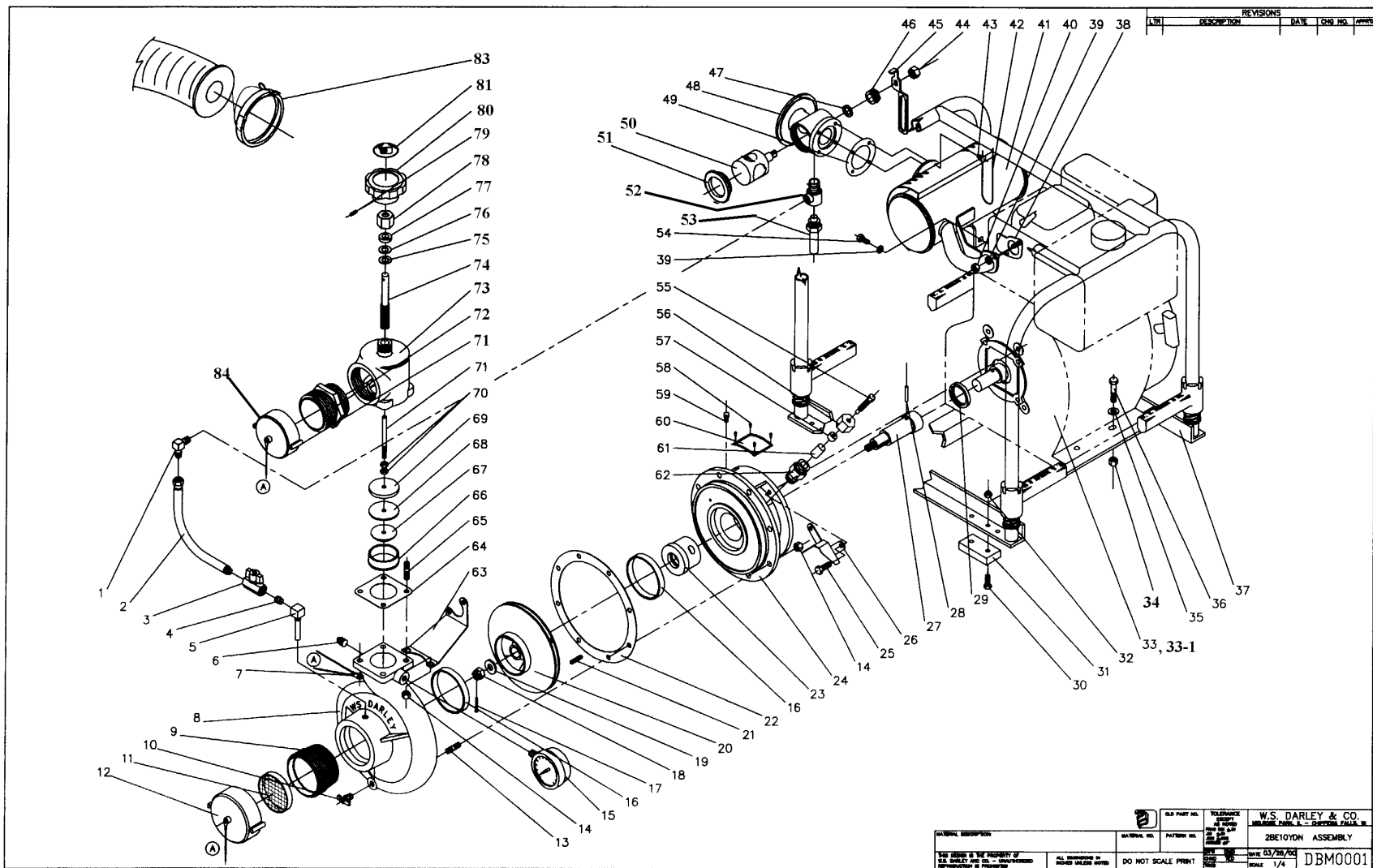


Figure 7-12 PUMP UNIT EXPLODED VIEW DRAWING DBM0001



**Table 7-12 2BE10YDN MATERIAL LIST Reference Drawing DBM0001**

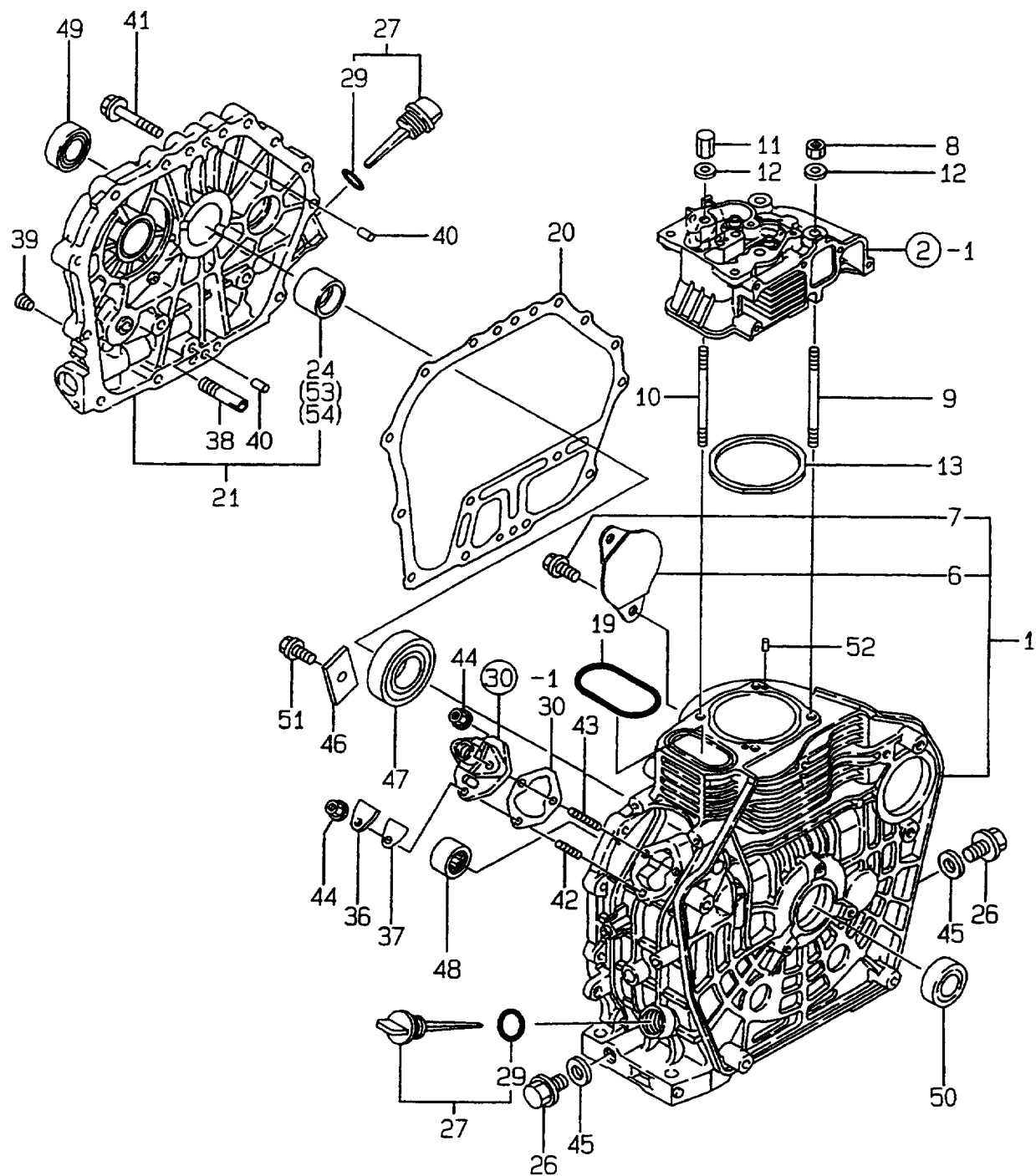
REP NO.	NAME OF PART	QTY	PART NO.	MATERIAL	STANDARDS
1	ADAPTER - 1/4 NPT X 3/8 TUBE X 90	1	3501505	360 BRASS	ASTM B16
2	PRIMER HOSE	1	4402314	PARKER HI-TEMP 836-6	SAE J516, J517
3	SHUT OFF VALVE	1	5200600	NICKEL PLATED FORGED BRASS	
4	CLOSE NIPPLE - 1/4 NPT	1	1081005	360 BRASS	ASTM B16
5	PRIMER SUCTION FITTING	1	4417201	360 BRASS	ASTM B16
6	PIPE PLUG	1	1080535	18-8 STAINLESS STEEL	ASTM A167, A240
7	LANYARD	2	4421500		
8	PUMP CASING	1	2050807	AL 319	ASTM SC64D MIL-A-8625F
9	SUCTION ADAPTER	1	1603600	BRONZE SAE 660	ASTM B505 MIL-B-16261-2
10	1/4" DRAIN COCK	1	5203600	360 HEX BRASS	ASTM B16
11	HYDRANT STRAINER	1	1121387	360 BRASS	ASTM B16
12	THREAD PROTECTOR	1	1001600	H.I. STYRENE	ASTM D 638
13	S.S. STUD 3/8NC X 1 1/4 LG.	8	3606202	18-8 STAINLESS STEEL	ASTM A167, A240
14	S.S. HEX NUTS 3/8 NC	12	5403003	18-8 STAINLESS STEEL	ASTM A167, A240
15	DISCHARGE PRESSURE GAUGE	1	2603026	2 1/2" LIQUID FILLED	
16	STATIONARY SEAL RING	2	3407000	BRONZE SAE 660	ASTM B505 MIL-B-16261-2
17	S.S. COTTER KEY 3/32 X 3/4 LG.	1	360S201	18-8 STAINLESS STEEL	ASTM A167, A240
18	IMPELLER NUT	1	5403434	18-8 STAINLESS STEEL	ASTM A167, A240
19	IMPELLER WASHER	1	3603319	303 STAINLESS STEEL	ASTM A581
20	IMPELLER	1	2907300	BRONZE 85-5-5-5	ASTM 62-82
21	IMPELLER KEY	1	3602405	316 STAINLESS STEEL	ASTM A276
22	PUMP CASING GASKET	1	3801800	CLOTH INSERTED NATURAL RUB- BER	ASTM D2000-4AA515A13B13
23	STUFFING BOX	1	2156400	BRONZE SAE 660	ASTM B505 MIL-B-16261-2
24	INBOARD HEAD	1	2801203	AL319	ASTM SC64D MIL-A-8625F
25	S.S. HEX HEAD CAP SCREW M8 X 1.25 X 25MM	4	5400807	18-8 STAINLESS STEEL	ASTM A167, A240
26	WATER SHIELD	1	3203700	316 STAINLESS STEEL	ASTM A276
27	IMPELLER SHAFT	1	5000904	316 STAINLESS STEEL	ASTM A276
28	S.S. RETAINING PIN - SPRING PIN 3/16 X 1 1/2 .	1	3605024	18-8 STAINLESS STEEL	ASTM A167, A240
29	OIL SEAL	1	3600557	CLIPPER 0150-09831	
30	S.S. HEX HEAD CAP SCREW 5/16 NC X 7/8 LG.	8	5400640	18-8 STAINLESS STEEL	ASTM A167, A240
31	MOUNTING PAD	4	4021300	MOLDED HARDCAST 116 PLASTIC	ASTM D638, D648, D790
32	S.S. HEX NYLOC NUTS 5/16 NC	8	5403400	18-8 STAINLESS STEEL	ASTM A167, A240

**Table 7-12** 2BE10YDN MATERIAL LIST Reference Drawing DBM0001 - Continued

REP NO.	NAME OF PART	QTY	PART NO.	MATERIAL	STANDARDS
33	DIESEL ENGINE	4	4214307	YANMAR L100AE-D	STM A167, A240
33-1	DIESEL ENGINE	1	4215903	YANMAR L100EE-D	
34	S.S. HEX NUTS 3/8NC	4	5403003	18-8 STAINLESS STEEL	ASTM A167, A240
35	S.S. FLAT WASHER 3/8	2	3603809	18-8 STAINLESS STEEL	ASTM A167, A240
36	S.S. HEX HEAD CAP SCREW 3/8NC X 1-3/4 LG.	4	5400619	18-8 STAINLESS STEEL	ASTM A167, A240
37	BASE	1	1683000	6061T6 ALUM TUBE & ANGLE	ASTM B241 & B210
38	EXHAUST GASKET	1	3819700	YANMAR 114650-13200	
39	LOCKWASHER, M8	4	3603528	18-8 STAINLESS STEEL	ASTM A167, A240
40	S.S. HEX NUT M8	2	5403105	18-8 STAINLESS STEEL	ASTM A167, A240
41	EXHAUST SILENCER	1	1220900		
42	SAFETY WIRE, .041 X 14"	2	4423600	302/304 STAINLESS STEEL	QQ-W-423B MS-20995
43	HEX BOLT, 1/4-20NC X 1.25	4	5400635	GRADE 8 STEEL	ASTM A354
44	LEVER NUT - TOP LOCK - S.S. 1/2NC	1	5403457	18-8 STAINLESS STEEL	ASTM A167, A240
45	LEVER	1	3009400	316 STAINLESS STEEL	ASTM A276
46	PACKING NUT	1	5403458	360 BRASS	ASTM B16
47	PACKING RING	2	3603913	GRAPHITE PACKING	ASTM F104 F517100B1M3
48	PRIMER BODY	1	2055700	81-3-7-9 CAST BRASS	ASTM B505-82A
49	PRIMER GASKET	1	3805601	S1200 CARBON FIBER	ASTM F104-F112231-M7
50	PRIMER PLUG	1	4421600	360 BRASS	ASTM B16
51	END CAP	1	1002000	81-3-7-9 CAST BRASS	ASTM B505-82A
52	PRIMER JET	1	4416704	81-3-7-9 CAST BRASS	ASTM B505-82A
53	PRIMER THROAT	1	4416806	360 BRASS	ASTM B16
54	S.S. HEX HEAD CAP SCREW M8X1.25X16MM	2	5400801	18-8 STAINLESS STEEL	ASTM A167, A240
55	PACKING SCREW	1	2156200	303 STAINLESS STEEL	ASTM A581
56	GLAND NUT	1	2150300	360 HEX BRASS	ASTM B16
57	GLAND STUD PISTON	1	2154500	303 STAINLESS STEEL	ASTM A581
58	SCREW- DRIVE, #4 X 1/4	4	5402820	ALUMINUM	
59	S.S. SOCKET HEAD CAP SCREW 1/4NC X 3/8 LG	1	5401400	18-8 STAINLESS STEEL	ASTM A167, A240
60	IDENTIFICATION TAG	1	1969000	BRASS	ASTM B36-91A
61	PACKING, PLASTALLIC GRAPHITE COMPOSITE	6	3817102	GARLOCK STYLE 926	NA
62	PACKING CYLINDER	1	2150800	360 HEX BRASS	ASTM B16

**Table 7-12** 2BE10YDN MATERIAL LIST Reference Drawing DBM0001 - Continued

REP NO.	NAME OF PART	QTY	PART NO.	MATERIAL	STANDARDS
63	SUPPORT BRACKET	1	4026300	316 STAINLESS STEEL	ASTM A276
64	DISCHARGE HEAD GASKET	1	3800800	CLOTH INSERTED NATURAL RUBBER	ASTM D2000-4AA515A13B13
65	S.S. STUD 3/8NC X 1 1/2 LG.	4	3606208	18-8 STAINLESS STEEL	ASTM A167, A240
66	CHECK VALVE SEAT	1	5260001	360 BRASS	ASTM B16
67	CHECK VALVE DIFFUSER	1	5300003	316 STAINLESS STEEL	ASTM A276
68	CHECK VALVE RUBBER	1	3800203	CLOTH INSERTED NATURAL RUBBER	ASTM D2000-4AA515A13B13
69	CHECK VALVE PLATE	1	5280202	316 STAINLESS STEEL	ASTM A276
70	S.S. JAM NUT 5/16NF	2	5403204	18-8 STAINLESS STEEL	ASTM A167, A240
71	CHECK VALVE STEM	1	5240103	316 STAINLESS STEEL	ASTM A276
72	DISCHARGE ADAPTER	1	1602400	60-0-2-38 BRASS	ASTM B124-86
73	DISCHARGE HEAD	1	2800509	AL 319	ASTM SC64D MIL-A-8625F
74	VALVE STEM	1	5240005	360 BRASS	ASTM B16
75	DISCHARGE HEAD STUFFING BOX GASKET	1	3800400	CLOTH INSERTED NATURAL RUBBER	ASTM D2000-4AA515A13B13
76	STUFFING BOX WASHER	1	3603701	360 BRASS	ASTM B16
77	CHECK VALVE STEM PACKING 1/8" X 13"	1.08	4404000	OARLOCK STYLE 8909	NA
78	GLAND NUT	1	2150601	360 HEX BRASS	ASTM B16
79	SOCKET SET SCREW, .25-20 NC	1	5402603	18-8 STAINLESS STEEL	ASTM A167, A240
80	HANDWHEEL	1	3001800	PHENOLIC PLASTIC	
81	DECAL - OPEN/CLOSE	1	1962102	LEXAN	
83	EXHAUST HOSE AND CLAMP	2	4402311		
84	THREAD PROTECTOR	1	1001900	H.I. STYRENE	ASTM D 638
	DISCHARGE VALVE ASSEMBLY	1	HA00213	ITEMS 66 THRU 84	
	PRIMER VALVE ASSEMBLY	1	AP01001	ITEMS 44 THRU 51	



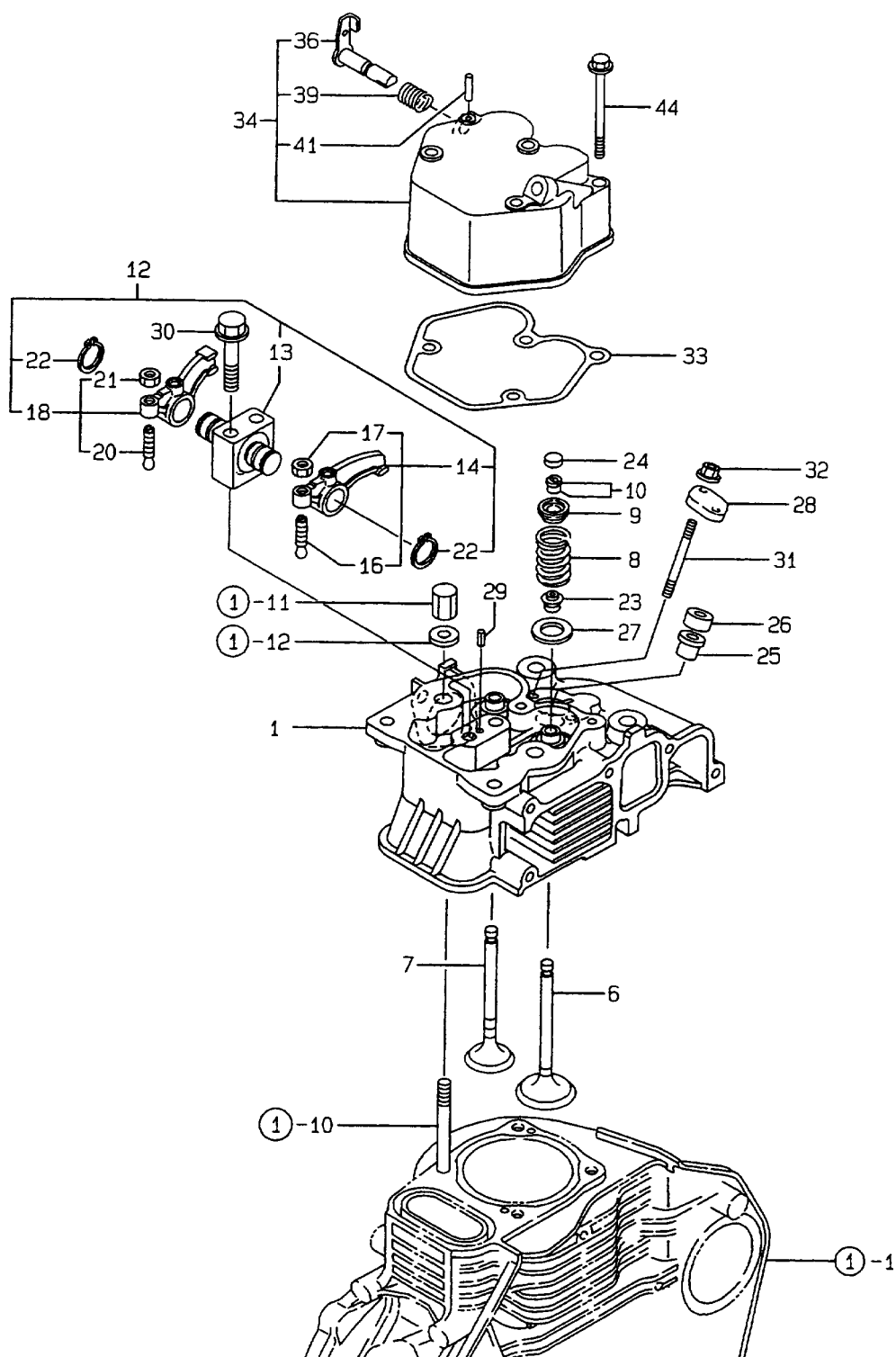
NOTE: CIRCLED 2 DENOTES FIGURE 7-14.

Figure 7-13 CYLINDER BLOCK L100EE-D



**Table 7-13** CYLINDER BLOCK L100EE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	4214300	BLOCK ASSY, CYLINDER	1
6	114350-01700	COVER, STARTER	1
7	26106-100122	BOLT M10X 12 PLATED	2
8	105025-01220	NUT 10	2
9	114650-01230	STUD, CYL. HEAD	2
10	114650-01240	STUD, CYL. HEAD	2
11	114650-01250	NUT 10	2
12	114650-01260	WASHER	4
13	114651-01330	GASKET, CYL. HEAD CMP	1
19	114650-01380	O-RING	1
20	114650-01412	GASKET, CRANK CASE	1
21	4222100	COVER (D), CRANK CASE	1
24	114650-02100	BEARING, MAIN	1
26	4214302	PLUG M16	2
27	114699-01760	CAP, W/LUB. OIL GAUGE	2
29	114299-01950	O-RING	2
30	114250-01800	SHIM SET	1
36	114250-01830	COVER, INSPEC. WINDOW	1
37	114250-01841	GASKET	1
38	114250-35150	PIPE, L.O. INLET	1
39	23876-010000	PLUG PT1/8, SCREW	1
40	114270-01600	PARALLEL PIN 8X12	2
41	26106-080352	BOLT M 8X 35 PLATED	16
42	26226-060182	STUD M 6X 18 PLATED	1
43	26226-060222	STUD M 6X 22 PLATED	2
44	26366-060002	NUT M 6	3
45	22190-160002	SEAL WASHER 16S	2
46	114299-02030	RETAINER	1
47	114650-02150	BALL BEARING	1
48	24162-152112	NEEDLE BEARING	1
49/50	24423-355008	SEAL, OIL	2
51	26106-080122	BOLT M 8X 12 PLATTED	1
52	22312-040080	PIN 4X8, STRAIGHT	2
53	114650-02200	MAIN BEARING US=0.25	1
54	114650-02210	MAIN BEARING US=0.50	1

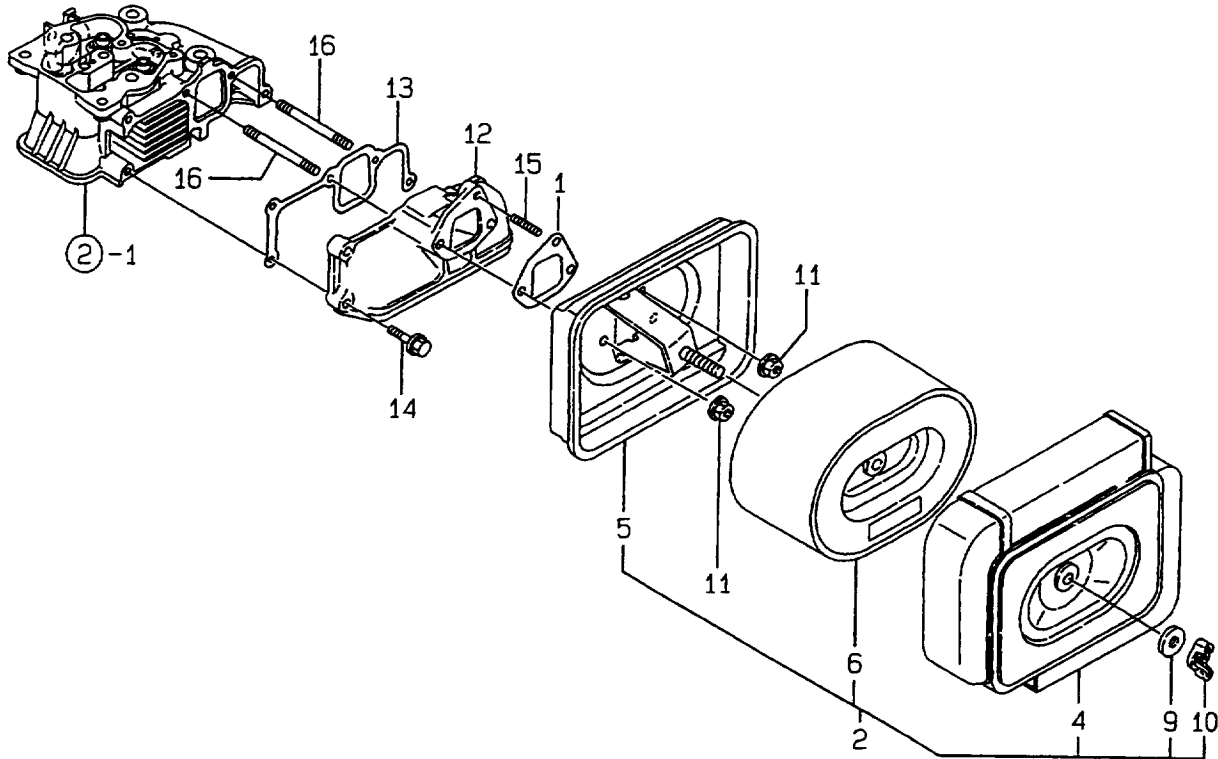


NOTE: CIRCLED 1 DENOTES FIGURE 7-13.

Figure 7-14 CYLINDER HEAD AND BONNET ASSEMBLY L100EE-D

**Table 7-14** CYLINDER HEAD & BONNET L100EE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	4222101	CYLINDER HEAD	1
6	114651-11100	VALVE, SUCTION	1
7	114651-11110	VALVE, EXHAUST	1
8	114650-11121	SPRING, VALVE	2
9	119620-11180	RETAINER, SPRING	2
10	27310-070001	COTTER ASSY	2
12	114651-11250	SUPPORT, CMP ARM	1
13	114651-11260	SUPPORT, ROCKER ARM	2
14	114651-11650	ARM ASSY, INTAKE	1
16	114250-11240	SCREW, VALVE ADJUST	1
17	26356-060002	LOCK NUT 6	1
18	114651-11660	ARM ASSY, EXHAUST	1
20	114250-11240	SCREW, VALVE ADJUST.	1
21	26856-060002	LOCK NUT 6	1
22	22242-000150	CIRCLIP 15	2
23	114650-11340	SEAL, VALVE STEM	2
24	104211-11370	CAP, VALVE	2
25	114771-11461	GASKET, NOZZLE	1
26	114771-11470	SPACER, NOZZLE	1
27	114650-11600	WASHER	2
28	114230-11901	RETAINER	1
29	22351-040008	SPRING PIN 4X 8	1
30	26106-080552	BOLT M8 X 55 PLATED	2
31	26226-060502	STUD M 6X 50	2
32	26366-060002	NUT M 6	2
33	4222102	GASKET, BONNET	1
34	4222103	BONNET ASSY, HEAD	1
36	114250-03591	SHAFT ASSY, DECOMP.	1
39	114250-03640	SPRING	1
41	23212-030160	PARALLEL PIN 3 X 16	1
44	26106-060702	BOLT N 6X 70 PLATED	3

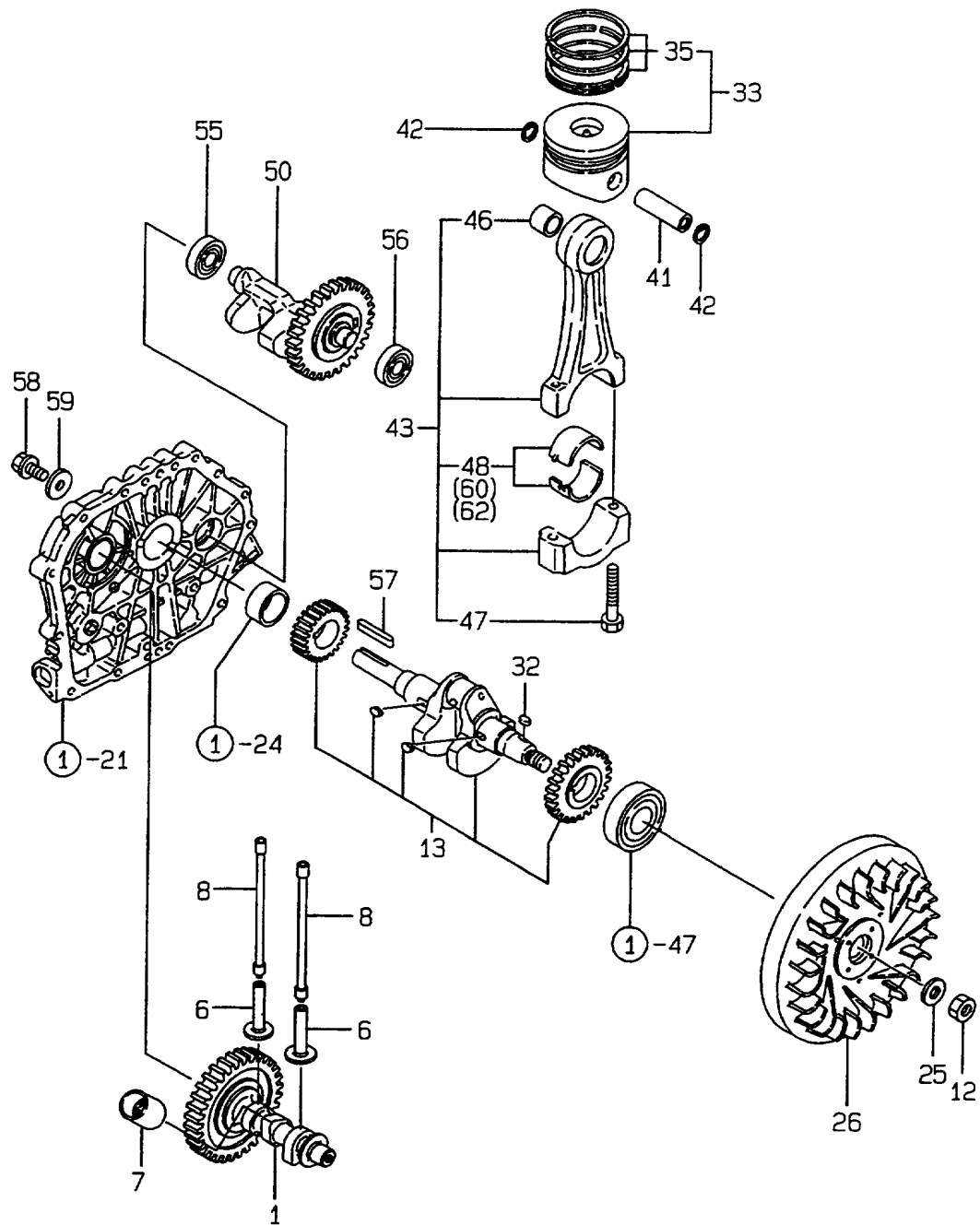


NOTE: CIRCLED 2 DENOTES FIGURE 7-14.

Figure 7-15 AIR CLEANER ASSEMBLY L100EE-D

Table 7-15 AIR CLEANER ASSEMBLY L100EE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	114650-12211	GASKET, AIR CLEANER	1
2	714650-12560	CLEANER ASSY, AIR	1
4	114650-12520	COVER, AIR CLEANER	1
5	114650-12530	CASE, AIR CLEANER	1
6	4209901	ELEMENT W/PRE-FILTER	1
9	114252-12560	WASHER, M8 SEAL	1
10	5403500	WING NUT M8	1
11	114250-12300	U-NUT	3
12	114699-12020	PIPE, AIR INTAKE	1
13	114650-12301	GASKET, AIR INTAKE	1
14	26106-060252	BOLT M 6 X 25 PLATED	3
15	26266-060142	STUD, M 6 X 14 PLATED	1
16	26226-060752	STUD, M 6 X 75	2

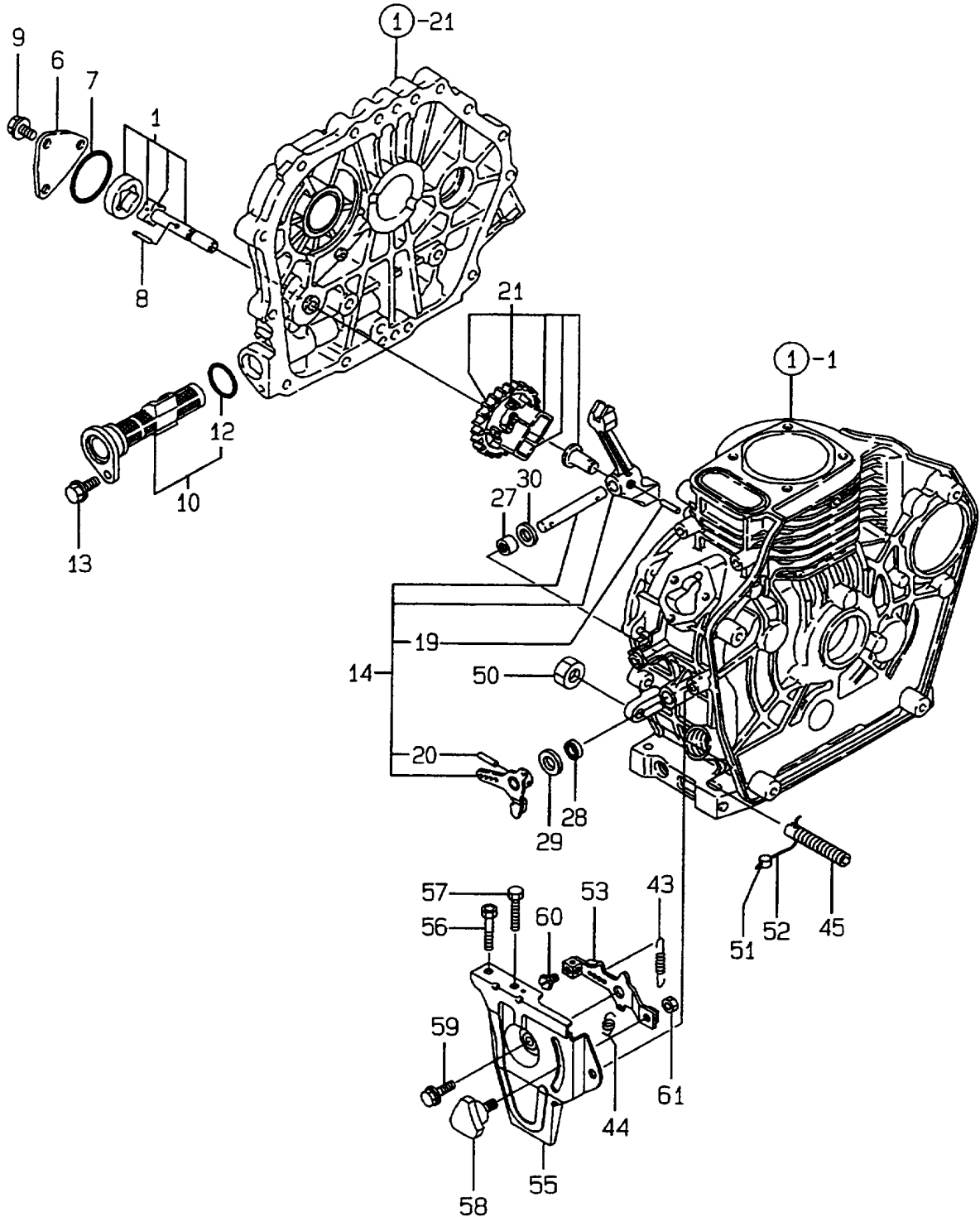


NOTE: CIRCLED 1 DENOTES FIGURE 7-13.

Figure 7-16 CRANKSHAFT, PISTON, AND CAMSHAFT ASSEMBLY L100EE-D

**Table 7-16** CAM/CRANK SHAFT & PISTON ROD L100EE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	714689-14580	CAMSHAFT (D) ASSY.	1
6	114650-14200	TAPPET	2
7	114771-14260	TAPPET, FUEL	1
8	114650-14401	ROD, PUSH	2
12	122710-01220	NUT (M18)	1
13	4222104	CRANKSHAFT ASSY, DGMO	1
25	114650-21551	WASHER, FLYWHEEL	1
26	114660-21402	FLYWHEEL (D)	1
32	22512-050140	KEY 5X 14	1
33	714652-22720	PISTON W/RINGS	1
35	714970-22500	RING SET, PISTON	1
41	114699-22300	PIN, PISTON D=23	1
42	129792-22400	CIRCLIP 23	2
43	714650-23700	ROD ASSY, CONNECTING	1
46	124060-23100	BUSH, PISTON PIN	1
47	105300-23200	BOLT, ROD	2
48	714650-23600	BEARING, CRANKPIN	1
50	714970-28511	SHAFT ASSY, BALANCER	1
55	24101-062034	BALL BEARING	1
56	24101-063034	BALL BEARING	1
57	160842-21150	KEY, 6.3 X 50	1
58	160842-21250	BOLT, 7/16-20UNF	1
59	160842-21260	WASHER	1
60	714650-23610	BEARING, PIN U.S = 0.25	1
62	714650-23620	BEARING, PIN U.S = 0.50	1



NOTE: CIRCLED 1 DENOTES FIGURE 7-13.

Figure 7-17 LUBRICATING OIL PUMP AND GOVERNOR L100EE-D

**Table 7-17** L.O. DEVICE & GOVERNOR CONTROL L100EE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	114650-32010	PUMP ASSY, LUB. OIL	1
6	114250-32070	COVER, LUB. OIL PUMP	1
7	103338-32570	O-RING	1
8	22312-030160	PARALLEL PIN 3X16	1
9	26476-060142	BOLT M 6X 14, TAPPING	3
10	114250-35110	STRAINER, LUB. OIL	1
12	24341-000224	O-RING 1A S-22.4	1
13	5400804	BOLT M 6X 16 (18-8SS)	1
14	714650-61500	LEVER ASSY, GOVERNOR	1
19/20	22322-030200	TAPER PIN 3X20	2
21	714685-61700	GOVERNOR ASSY	1
27	114270-61520	NEEDLE BEARING FJ810	2
28	114770-61600	SEAL, OIL	1
29	114770-61610	WASHER, THRUST	1
30	114770-61190	WASHER	1
43	114970-66010	SPRING, REGULATOR	1
44	114250-66200	SPRING, RETURN	1
45	114651-66500	TORQUE SPRING ASSY	1
50	26696-100002	NUT M10	1
51	135210-61090	LEAD	2
52	22451-060000	WIRE 0.6	2
53	114250-66050	HANDLE, REGULATOR	1
55	114299-66100	STAY HANDLE	1
56	114250-66440	BOLT, ADJUSTING	1
57	102100-67080	BOLT, ADJUSTING	1
58	160725-78350	KNOB, (W/M6 X 15)	1
59	5400804	BOLT M 6X 14 PLATED	1
60	26117-040088	BOLT M 4X 8 PLATED	1
61	26347-060002	U-NUT M 6 PLATED	1



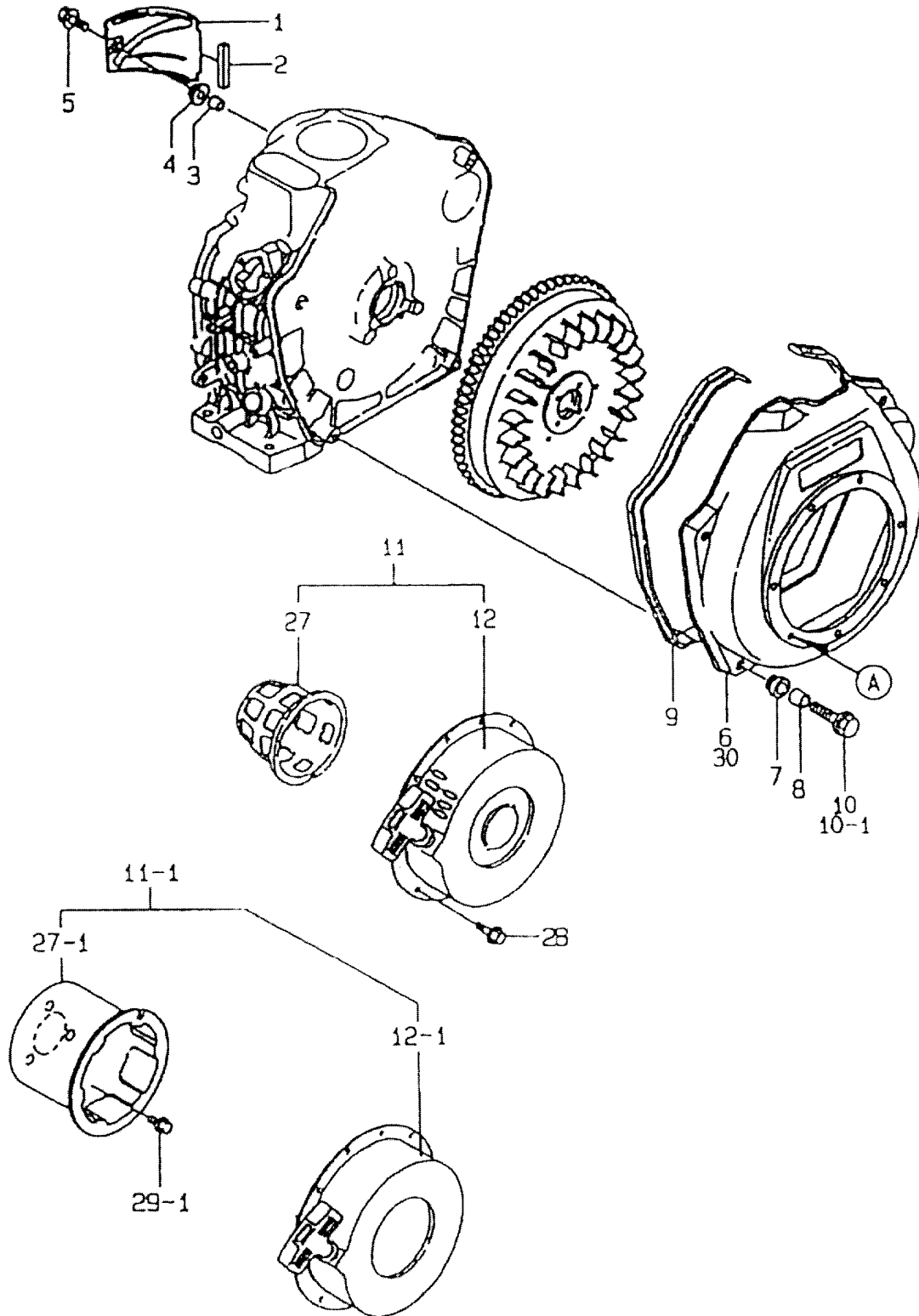


Figure 7-18 COOLING AND STARTING DEVICE L100EE-D and L100AE-D

**Table 7-18** COOLING & STARTING DEVICE L100EE-D and L100AE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	114650-45201	COVER	1
2	114350-45320	RUBBER SEAL	1
3	114350-45340	COLLAR	1
4	183720-55210	GROMMET	1
5	5400800	BOLT, M6 x 20, TAPPING	1
6	114688-45102	CASE, FAN	1
7	114250-45301	RUBBER CUSHION	4
8	114250-45310	COLLAR	4
9	114650-45330	FAN CASE SEAL	1
10	5400805	BOLT, FAN CASE	4
10-1	5400805	BOLT, FAN CASE	4
11	714660-76820	RECOIL START ASSEMBLY	1
11-1	714660-76821	RECOIL START ASSEMBLY	1
12	114660-76250	RECOIL START	1
12-1	114660-76251	RECOIL START	1
27	114660-76590	STARTER PULLEY	1
27-1	114660-76592	STARTER PULLEY	1
28	26106-060082	BOLT, M6 x 8 PLATED	4
29-1	26106-060122	BOLT, M6 x 12 PLATED	3

**NOTE**

The engines are supplied with two recoil start assemblies, to identify the correct assembly you will need to know the engine serial number.

Engines with serial number preceding 01084 refer to Recoil Rope Assembly Ref. No. 11.

Engines with serial number 01084 and later refer to Recoil Rope Assembly Ref. No. 11-1.

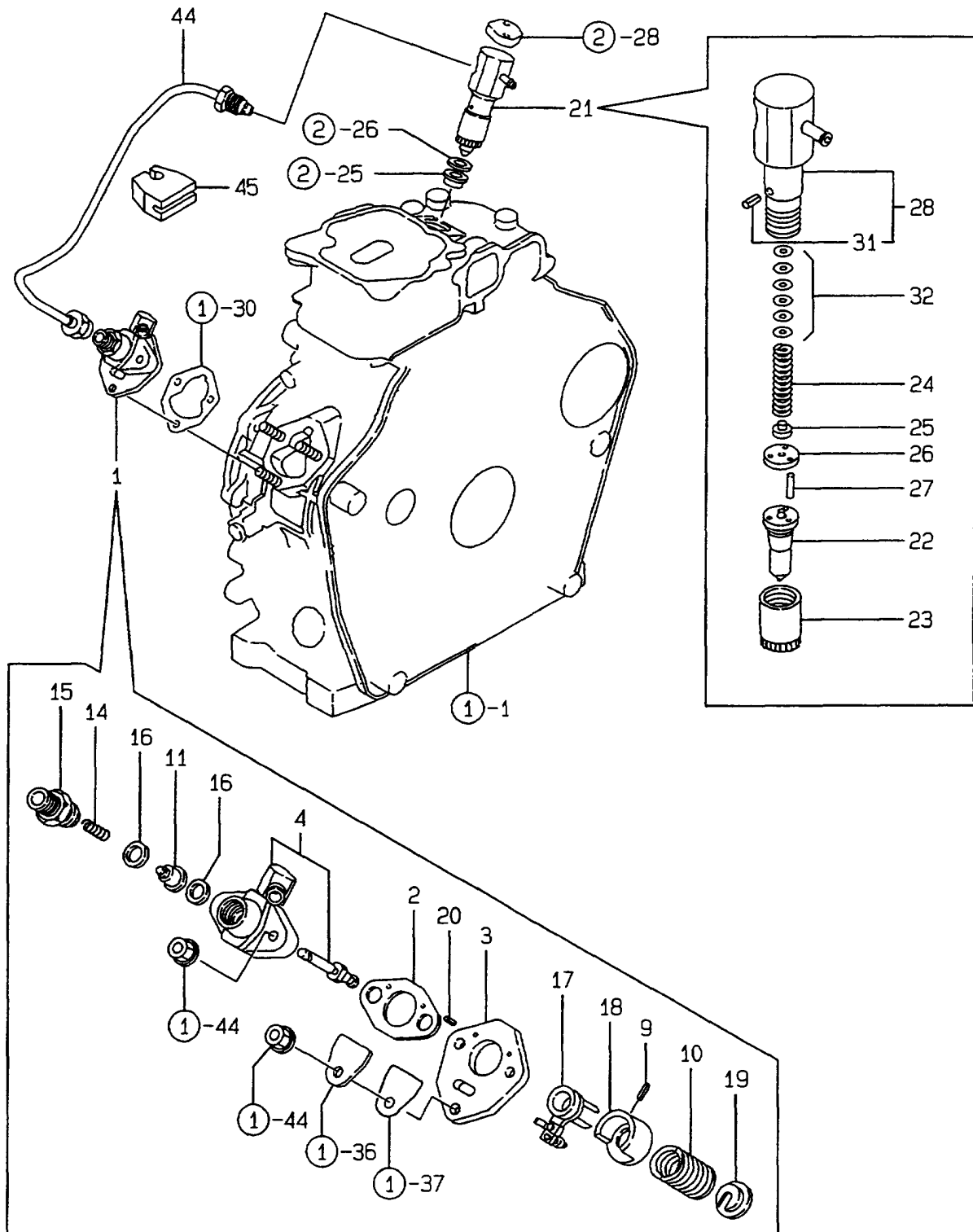
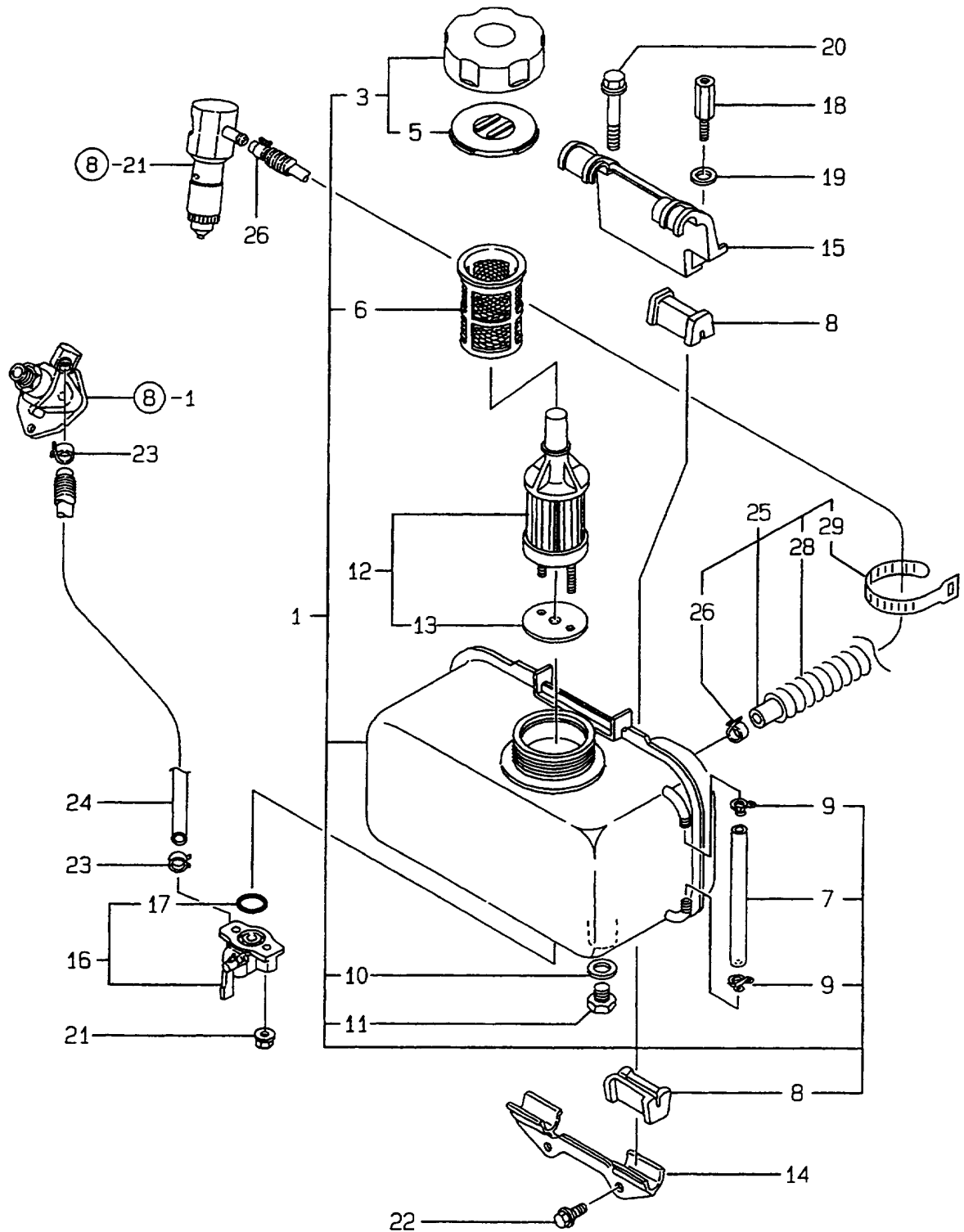


Figure 7-19 FUEL INJECTION PUMP AND VALVE L100EE-D

**Table 7-19** FUEL INJECTION PUMP & VALVE L100EE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	714970-51700	PUMP ASSY, F. INJECT.	1
2	105546-51020	GASKET	1
3	114250-51080	PLATE	1
4	114970-51100	BODY, F. I. PUMP	1
9	22351-030008	SPRING PIN 3X 8	1
10	114250-51160	SPRING	1
11	114650-51300	VALVE ASSY, DELIVERY	1
14	105546-51330	SPRING, DELIV. VALVE	1
15	114250-51340	HOLDER, F.I.P. DELIVERY	1
16	124550-51350	GASKET, DELIVERY	2
17	114250-51600	LEVER ASSY, CONTROL	1
18	114250-51640	SEAT (A), SPRING	1
19	114250-51650	SEAT (B), SPRING	1
20	22351-020006	SPRING PIN 2X 6	2
21	714651-53100	VALVE ASSY, F. INJECT.	1
22	114651-53000	NOZZLE ASSY, F. INJECT.	1
23	119593-53080	NUT, NOZZLE CASE	1
24	114250-53120	SPRING, NOZZLE	1
25	119593-53130	RETAINER, SPRING	1
26	114775-53140	SPACER, VALVE STOP	1
27	114775-53210	PIN	2
28	114775-53100	HOLDER ASSY	1
31	114775-53330	PIN	1
32	114250-53400	SHIM PACK	1
44	114651-59801	PIPE, FUEL INJECTION	1
45	114650-59850	BRACKET, PIPE	1



NOTE: CIRCLED 8 DENOTES FIGURE 7-19.

Figure 7-20 FUEL TANK AND FUEL LINE L100EE-D

**Table 7-20** FUEL TANK & FUEL PIPE L100EE-D

REF NO.	PART NO.	DESCRIPTION	QTY
1	714650-55130	TANK ASSY, FUEL	1
3	114288-55040	CAP ASSY, TANK	1
5	114288-55080	VALVE	1
6	114250-55100	FILTER, FUEL	1
7	114650-55150	HOSE, GAUGE	1
8	114250-55201	DAMPER FUEL TANK	1
9	103854-55220	CLAMP	2
10	23414-080000	GASKET 8, ROUND	1
11	105300-55080	PLUG, DRAIN	1
12	114250-55121	FILTER, FUEL OIL	4
13	114250-55130	GASKET	1
14	114299-55210	STAY	1
15	114699-55230	STAY (B)	1
16	114250-55300	COCK ASSY, FUEL	1
17	24341-000150	O-RING 1A S-15.0	1
18	114650-55810	BOLT, LIFTING	1
19	3600807	WASHER 8	1
20	5400803	BOLT M 8X 45 (18-8SS)	1
21	5403103	NUT M 6 (18-8SS)	2
22	26476-060142	BOLT M 6X 14, TAPPING	2
23	4402606	CLIP, HOSE	2
24	114250-59091	PIPE, FUEL OIL	4
25	114652-59300	PIPE, FUEL RETURN	1
26	4402606	CLAMP 9	2
28	114652-59310	TUBE, PROTECT	1
29	121750-59890	CLAMP 140	1

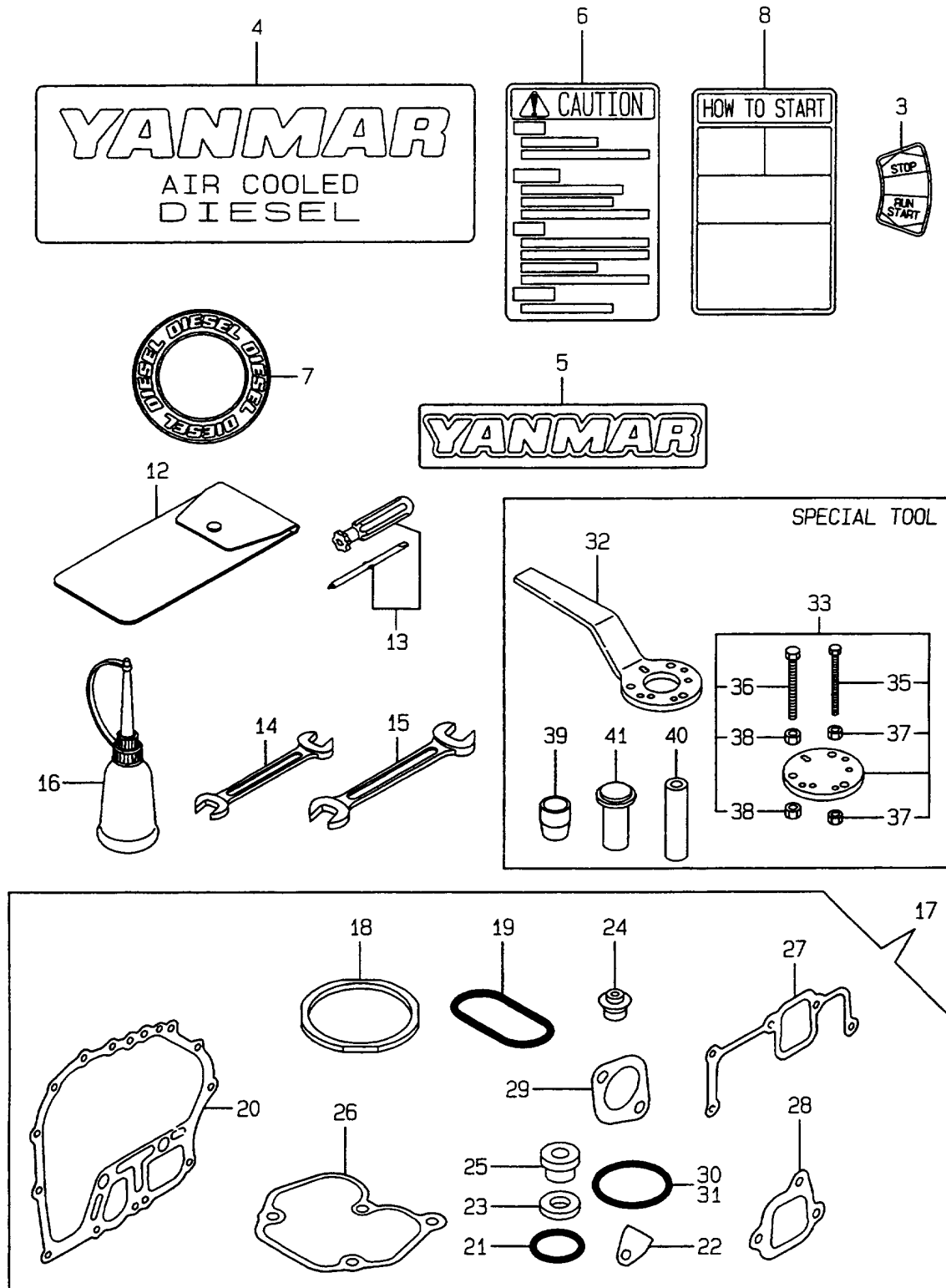


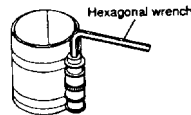
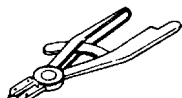


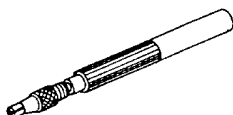

Figure 7-21 LABEL, TOOL, AND GASKET SET L100EE-D

**Table 7-21** LABEL, TOOL, & GASKET SET L100EE-D

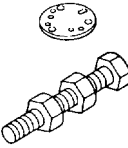

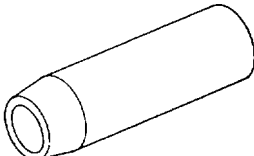


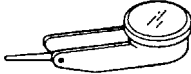
REF NO.	PART NO.	DESCRIPTION	QTY
3	183250-07230	LABEL, OPERATION	1
4	114250-07090	LABEL, AIR COOLED	1
5	114250-07111	LABEL, YANMAR	1
6	114268-07240	LABEL, CAUTION	1
7	114250-07350	LABEL, YANMAR DIESEL	1
8	114268-07350	LABEL, HOW TO START	1
12	114250-92600	BAG, TOOL	1
13	160330-92730	SCREWDRIVER	1
14	28110-100120	WRENCH 10 X 12	1
15	28110-140170	WRENCH 14 X 17	1
16	28210-000150	FEEDER, OIL	1
17	714651-92600	GASKET SET	1
18	114651-01330	GASKET, CYL. HEAD	1
19	114650-01380	O-RING	1
20	114650-01412	GASKET, CRANK CASE	1
21	114299-01950	O-RING	2
22	114250-01841	GASKET	1
23	22190-160002	SEAL WASHER 16S	2
24	114650-11340	SEAL, VALVE STEM	2
25	114250-11460	GASKET, NOZZLE	1
26	114650-11310	GASKET, BONNET	1
27	114650-12301	GASKET, AIR INTAKE	1
28	114650-12211	GASKET, AIR CLEANER	1
29	114650-13201	GASKET, (NON-ASB)	1
30	103338-32570	O-RING	1
31	24341-000224	O-RING 1A S-22.4	1
32	114250-92101	F.W. LOCKING HANDLE	1
33	114250-92130	REMOVER, FLYWHEEL	1
35	26116-060454	BOLT M 6X 45 PLATED	4
36	26116-080454	BOLT M 8X 45 PLATED	3
37	26716-060002	NUT M 6	8
38	26716-080002	NUT M 8	6
39	114668-92300	GUIDE, OIL SEAL	1
40	114650-92310	INSTALLING TOOL	1
41	114650-92350	INSTALLING TOOL	1



**Table 7-22 TOOLS, METERS AND SERVICE ACCESSORIES**

Keep the following tools, jigs, and other service items on hand to ensure accurate measurement and diagnosis and efficient servicing.		
NAME OF TOOL	DESCRIPTION (YANMAR CODE NO.)	ILLUSTRATION
YANMAR SERVICE TOOL SET	TYPE A (INCLUDING 65 TOOLS) (955000-0001) TYPE B (INCLUDING 46 TOOLS) (955000-00002)	
PISTON INSERTING TOOL	COMMERCIALY AVAILABLE (955500-02476) FOR Ø60-125	 Hexagonal wrench
BORE PLIERS	(28190-000130) (INCLUDED IN YANMAR SERVICE TOOL SET)	
SHAFT PLIERS	(28190-000020) (INCLUDED IN YANMAR SERVICE TOOL SET)	
PISTON RING REMOVER	(135410-92140)	
CLEANING NEEDLE FOR FUEL INJECTION VALVE	WIRE (USE Ø 0.19) COMMERCIALY AVAILABLE PINVISE COMMERCIALY AVAILABLE (28210-000010)	
FLYWHEEL END NUT WRENCH	SPECIAL-PURPOSE TOOL FOR TIGHTENING THE CRANKSHAFT END NUT. (114250-92101)	

**Table 7-22** TOOLS, METERS AND SERVICE ACCESSORIES - Continued

Keep the following tools, jigs, and other service items on hand to ensure accurate measurement and diagnosis and efficient servicing.		
NAME OF TOOL	DESCRIPTION (YANMAR CODE NO.)	ILLUSTRATION
FLYWHEEL EXTRACTOR*	*11425092130)  BOLT 26116- 060504 PCS 4 NUT 26716- 060002 PCS 8	
OIL SEAL FITTING TOOL*	CODE: 114650-92310	
OIL SEAL FITTING GUIDE*	AFTER INSERTION OF SEAL INTO CRANKCASE COVER, USE THIS TOOL TO INSTALL CRANKCASE COVER ON CYLINDER BLOCK. JIG FOR INSERTING CRANKSHAFT AND CAMSHAFT OIL SEALS. CODE 114668-92300	
VALVE STEM SEAL FITTING TOOL*	CODE: 114650-92350	
DIAL GAUGE	TO MEASURE BENDING AND GAP OF THE SHAFT, SURFACE DISTORTION, ETC.	
TEST INDICATOR	TO MEASURE POSITIONS TOO NARROW AND TOO DEEP FOR NORMAL DIAL INDICATORS.	

**Table 7-22 TOOLS, METERS AND SERVICE ACCESSORIES - Continued**


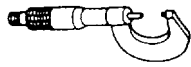


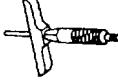
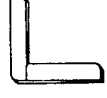


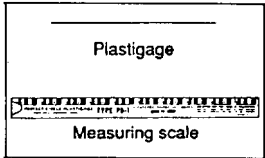

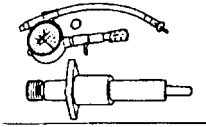
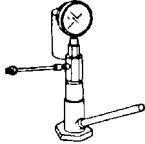
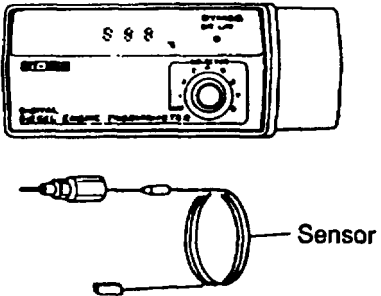
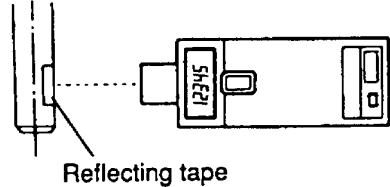
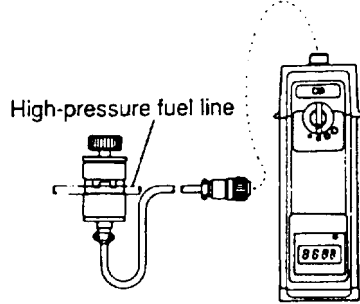
Keep the following tools, jigs, and other service items on hand to ensure accurate measurement and diagnosis and efficient servicing.		
NAME OF TOOL	DESCRIPTION (YANMAR CODE NO.)	ILLUSTRATION
MAGNET STAND	TO ATTACH DIAL INDICATORS TO VARIOUS POSITIONS FOR EASY ACCURATE VIEWING.	
MICROMETER	TO MEASURE THE O.D. OF THE CRANKSHAFT, PISTON, PISTON PIN, ETC.	
CYLINDER GAUGE	TO MEASURE THE I.D. OF THE CYLINDER LINERS AND BEARINGS.	
VERNIER CALIPERS	TO MEASURE OUTSIDE DIAMETER, DEPTH, THICKNESS, WIDTH, ETC.	
DEPTH MICROMETER	TO MEASURE VALUE SINKAGE AND LINER PROJECTION.	
SQUARE	TO MEASURE THE INCLINATION OF VALVE SPRINGS AND SQUARENESS OF VARIOUS PARTS.	
V-BLOCK	USE WHEN MEASURING THE BENDING OF A SHAFT.	
TORQUE WRENCH	USE WHEN TIGHTENING BOLTS AND NUTS WITH SPECIFIED TORQUES.	

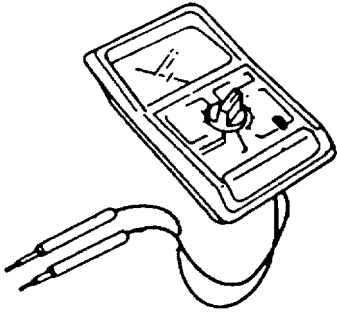
Table 7-22 TOOLS, METERS AND SERVICE ACCESSORIES - Continued

Keep the following tools, jigs, and other service items on hand to ensure accurate measurement and diagnosis and efficient servicing.		
NAME OF TOOL	DESCRIPTION (YANMAR CODE NO.)	ILLUSTRATION
PLASTIGAGE	TO MEASURE OIL CLEARANCE BETWEEN CRANKPIN AND MAIN BEARING.	 The illustration shows a rectangular box labeled 'Plastigage' at the top. Below the label is a horizontal measuring scale with markings in both inches and millimeters. The text 'Measuring scale' is printed below the scale.
THICKNESS GAUGE		 The illustration shows a set of three thin, flat metal gauges fanned out, used for measuring the thickness of various engine components.
COMPRESSION GAUGE		 The illustration shows a mechanical compression gauge with a circular dial and a needle, attached to a long, thin hose with a fitting at the end.
NOZZLE TESTER (737600-93502)		 The illustration shows a vertical mechanical device with a pressure gauge at the top, a central shaft, and a horizontal arm with a nozzle at the bottom.
HIGH PRESSURE PIPE (124233-93400)		
THERMOMETER DIGITAL TYPE MODEL: BT-800 (955000-08000)		 The illustration shows a digital thermometer unit with a rectangular face, a digital display showing '88.8', and a control knob. Below the unit is a separate sensor probe with a coiled cable and a label 'Sensor' pointing to it.
SENSOR (955000-08640)		

**Table 7-22 TOOLS, METERS AND SERVICE ACCESSORIES - Continued**

Keep the following tools, jigs, and other service items on hand to ensure accurate measurement and diagnosis and efficient servicing.		
NAME OF TOOL	DESCRIPTION (YANMAR CODE NO.)	ILLUSTRATION
TACHOMETER PHOTOELECTRIC TYPE (NON-CONTACTING) MODEL HT-441 (95500H-T4410)		<p>Revolving body</p>  <p>Reflecting tape</p>
REFLECTING TAPE 10 PIECES) (955000-01041)		
HIGH-PRESSURE FUEL PIPE CLAMPING TYPE          MODEL: GE-450 (955000-01045)		 <p>High-pressure fuel line</p>

**Table 7-22** TOOLS, METERS AND SERVICE ACCESSORIES - Continued

Keep the following tools, jigs, and other service items on hand to ensure accurate measurement and diagnosis and efficient servicing.		
NAME OF TOOL	DESCRIPTION (YANMAR CODE NO.)	ILLUSTRATION
CIRCUIT TESTER	TO MEASURE RESISTANCE, DC VOLTAGE, AC VOLTAGE, DC CURRENT, AND FOR CONTINUITY TESTING.	

## CHAPTER 8

### WARRANTY

#### 8.1 GENERAL.

A copy of the warranty appears on the following pages. Below are some commonly asked questions and answers regarding the warranty. The warranty covers the entire pump unit, including engine and exhaust hose. The warranty period is for 12 months beginning upon acceptance of the units at the W. S. Darley facility in Chippewa Falls, WI.

Q: Who pays cost of replacement parts?

A: Darley will pay the cost of all replacement parts covered under this warranty.

Q: Who pays cost of labor for warranty repairs?

A: Darley will pay cost of labor for warranty repairs authorized by us.

Q: Who pays related transportation costs?

A: Darley will pay the cost of shipping of warranty parts within the contiguous U.S.A.

Q: What are the excluded conditions?

A: The following shall be excluded from the warranty.

- a. Repair when normal use has exhausted the life of a part.
- b. Consumable parts, such as but not limited to: pump packing, O-rings, gaskets, filters.
- c. Routine maintenance and tune up as recommended by the operator's manual. The warranty shall be null and void if the contractor determines actions such as but not limited to the following have taken place.
  1. The product has been abused, improperly maintained, improperly operated, modified, repaired by unauthorized personnel, repaired with unauthorized parts.
  2. The product has not been maintained and/or operated in accordance with the directions of the operations manual.

Q: What warranty coverage of subcontracted components is provided?

A: Warranty coverage for all subcontracted components will carry through W. S. Darley or our local representative. If desirable, engine warranties can carry through Yanmar, Darley or trained Navy personnel. Exhaust hose warranties will carry through Darley or the hose manufacturer.

Q: Will warranty be extended upon completion of warranted work?

A: The warranty for the covered part will not be extended, however, the replaced item will be covered for an additional 12 month period upon completion of the warranted work.

Details on the above can be found in the warranty.

#### 8.2 LIMITED WARRANTY

##### 8.2.1 Scope.

W. S. Darley & Co. (hereafter, "Contractor"), subject to the terms and conditions of this Limited Warranty (the "Warranty"), will, at its option, repair or replace, in whole or in part, any Model 2BE10YD fire pump (hereaf-

ter, "Pump") that Contractor determines to be defective in materials or workmanship. The Warranty shall apply in favor of the United States Department of Defense (the "Customer") for a period of one year (the "Warranty Period"), and for each such warranted Pump shall start from the date indicated in block 21 of the DD form 250, the date shown on that Pump's commercial or government bill of lading as the date of first tender to Customer FOB Contractor's plant shall be deemed the Start Date. Any interpretation of the scope or operation of this Warranty shall be made with reference to applicable Illinois law.

#### 8.2.2 Notification.

Customer shall immediately cease using any Pump identified as potentially defective, and shall within the Warranty Period for such Pump notify Contractor in writing of the nature of such claimed defect, with such notice sent to Contractor's Illinois plant: 2000 Anson Drive, Melrose Park, IL 60160-1087, facsimile (708) 345-8993. Customer shall complete Contractor's standard Warranty claim documentation to assist with identification of any Pump, its usage, and specific claimed defect.

#### 8.2.3 Remedy for Operating Defects.

Contractor shall determine the cause of any claimed Pump defect, and if covered, shall provide, at its election, one of the following Warranty remedies:

##### A. Field Repair.

Authorize field repair by either a Contractor-authorized service center or by Contractor-approved trained Customer personnel, with Contractor paying all reasonable agreed labor costs for replacement part installation only, with all such repairs conducted by using only instruction and repair parts issued by Contractor. Customer shall, according to any call tag and returned goods authorization form or other instructions issued by Contractor, return any unused or defective parts requested by Contractor.

##### B. Return for Repair or Replacement.

Contractor may, by issuing a returned goods authorization and transport instructions, request return of an entire Pump unit to a designated plant location for repair or, at Contractor's option, replacement with a new or reconditioned Pump unit.

##### C. Substitution.

Contractor may, at its option, replace a defective Pump with a substitute product meeting all material specifications of a new or reconditioned Model 2BE10YD Pump, if in Contractor's reasonable judgment such substitute pump is required to cover Contractor's Warranty obligations to Customer in a commercially reasonable manner.

##### D. Packing and Transportation Costs.

Contractor will pay reasonable standard ground transportation costs for shipment of replacement parts, replacement or substitute Pump units (and for any requested return parts or units) within the 48 contiguous states and District of Columbia, subject to Customer's compliance with Contractor's return shipment guidelines. Customer will pay for all labor and any related costs of handling or packaging any parts or units to be returned to Contractor, subject to Customer's compliance with applicable return instructions. Customer will retain responsibility for damage to any parts or units during transportation to or from Customer.

#### 8.2.4 Warranty Extension.

Contractor shall extend its Warranty to any replacement parts or Pump units (including substitutions) provided or authorized by Contractor to remedy any operating Pump defect covered by this Warranty. In the case of all replacement parts or units, any such Warranty extension shall apply with the applicable Start Date beginning on



the date such part or unit is shipped from Contractor's (or its authorized representative's) plant, based on Contractor's records. The Warranty Period of any extension shall be one year. Notwithstanding anything herein to the contrary, in no case shall any Pump unit Warranty Period exceed two years from the original Warranty Start Date for that unit, such that Contractor shall have no further obligation to repair or replace any Pump following two years from the Warranty Start Date for that Pump.

#### 8.2.5 Exclusions and Conditions.

A. Contractor's performance under this Warranty is expressly conditioned upon Customer's continuing substantial performance of its obligations under the contract governing the subject matter of this Warranty, and upon Customer's cooperation with the reasonable identification, notification, documentation and logistic requirements for Contractor to perform its obligation under this Warranty. Contractor's performance there under shall also be excused if prevented by Act of God, war, strike, or impossibility.

B. In no event shall Contractor or any of its suppliers or distributors be liable to Customer or to any other person for any incidental, consequential, or other damages (including but not limited to personal injury, death, property damage, loss of time or interruption of operations or related costs) arising out of or relating to the use (including any malfunction) or inability to use any original, repaired, replaced, or substitute Pump, regardless of the reason for such damage, loss or injury. Contractor further disclaims any liability whatsoever for any damage, loss or injury relating to any modifications which Customer may make to any Pump, regardless of any actual or constructive knowledge Contractor may have of such modifications.

C. The following repairs or replacement expenses are specifically excluded from the scope of this Warranty: 1) Non-defective parts worn, exhausted or consumed through normal usage; 2) Consumable parts, including but not limited to: pump packing, O-rings, gaskets, filters; and 3) Routine maintenance and tune up as recommended in the operator's manual.

D. This Warranty shall be completely voidable in relation to any claimed defective Pump(s) if Contractor determines that any Pump has been mishandled, neglected or abused as a result of, without limitation, improper maintenance, operation, modification, or unauthorized repair (as to either parts or persons). The voiding of this warranty as to certain Pumps does not void this Warranty generally as to properly maintained and operated Pumps.

**E. THIS LIMITED WARRANTY IS THE ONLY WARRANTY MADE BY CONTRACTOR, AND IS IN LIEU OF ANY OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER ASSUMES ALL RISKS OF USING ALL PUMPS FOR ALL FORE-SEEN AND UNFORESEEN PURPOSES.**



## APPENDIX A

### COMMERCIAL USER SCHEDULED MAINTENANCE

#### **WARNING**

**SHUT OFF THE ENGINE BEFORE PERFORMING ANY MAINTENANCE. IF THE ENGINE MUST BE RUN, MAKE SURE THE AREA IS WELL VENTILATED. THE EXHAUST CONTAINS POISONOUS CARBON MONOXIDE GAS.**

#### **CAUTION**

**AFTER THE ENGINE HAS BEEN USED, CLEAN THE ENGINE IMMEDIATELY WITH A CLOTH TO PREVENT CORROSION AND TO REMOVE SEDIMENT.**

#### **CAUTION**

**ONLY USE GENUINE DARLEY AND YANMAR PARTS. THE USE OF REPLACEMENT PARTS THAT ARE NOT OF EQUIVALENT QUALITY MAY DAMAGE THE ENGINE.**

#### **NOTE**

COMMERCIAL USER ITEMS MARKED "•" SHOULD BE SERVICED BY AN AUTHORIZED W. S. DARLEY REPRESENTATIVE OR YANMAR DEALER, UNLESS THE OWNER HAS THE PROPER TOOLS AND IS MECHANICALLY PROFICIENT.

Periodic checks and maintenance are very important for keeping the engine in good condition and durable. [Table A-1](#) indicates which checks to make and when to make them.

**Table A-1** COMMERCIAL USER MAINTENANCE SCHEDULE

REGULAR SERVICE PERIOD →	DAILY CHECK	FIRST MONTH OR 20 HRS.	EVERY 3 MONTHS OR 100 HRS.	EVERY 6 MONTHS OR 500 HRS.	EVERY YEAR OR 1000 HRS.
ITEM ↓					
1 CHECK AND REPLENISH FUEL OIL.					
2 DRAIN FUEL FROM F.O. TANK.	(MONTHLY)				
3 CHECK AND REPLENISH LUBE OIL.					
4 CHECK FOR OIL LEAKAGE.					
5 CHECK AND TIGHTEN ENGINE PARTS.				• TIGHTEN HEAD BOLTS	
6 CHANGE LUBE OIL.		1ST TIME	2ND & THERE- AFTER		
7 CLEAN OIL FILTER.				(REPLACE IF NECESSARY)	
8 CHECK AND REPLACE AIR CLEANER ELE- MENT.	(SERVICE MORE FREQUENTLY WHEN USED IN DUSTY AREAS.)		(REPLACE)		
9 CLEAN FUEL FILTER.					• (CHANGE)
10 CHECK FUEL INJECTION PUMP.				•	
11 CHECK FUEL INJECTION NOZZLE.				•	
12 CHECK FUEL PIPING.				(REPLACE IF NECESSARY)	
13 ADJUST VALVE HEAD CLEARANCE FOR INTAKE AND EXHAUST VALVES.		• 20 HRS 1ST TIME		•	
14 LAP INTAKE AND EXHAUST VALVES.					•
16 REPLACE PISTON RINGS.					•

## A.1 FUEL SYSTEM MAINTENANCE

### A.1.1 Fuel Selection.

Selection and handling of fuel oil:

- (1) Selection of fuel oil: The pump unit is able to operate using commercial Grade 2 diesel fuel, NATO Symbol F-76 or JP-5.
- (2) Keep dust and water out of the fuel.

### **CAUTION**

**ONLY USE THE RECOMMENDED DIESEL FUEL OIL. USE OF NON-RECOMMENDED FUEL MAY CAUSE CLOGGING IN THE FUEL OIL STRAINER, FUEL INJECTION PUMP, AND FUEL INJECTION NOZZLE.**

This clogging often causes sudden engine stops after starting.

Fuel should have a cetane value of more than 45 in order to prevent difficult starting, misfiring, and white exhaust smoke.

Diesel fuel oil substitutes are not recommended; they may be harmful to the fuel system components.

Fuel should be free of water or dust because these cause trouble in the fuel injection pump and nozzle.

### A.1.2 Renew Engine Fuel.

### **WARNING**

**DIESEL FUEL AND JP-5 VAPORS ARE COMBUSTIBLE. WHEN WORKING ON ANY PART OF FUEL SYSTEM, PROVIDE ADEQUATE VENTILATION AND AVOID HIGH HEAT AND OPEN FLAME.**

To renew engine fuel:

- a. Loosen drain plug at base of fuel tank and drain fuel from fuel tank (see Figure 4–1).

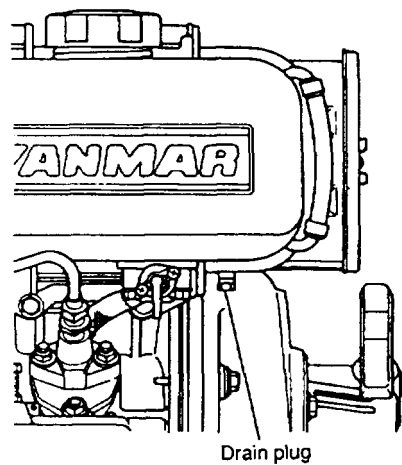


Figure A-1 Drain plug

- b. Replace fuel tank drain plug and tighten.
- c. Remove fuel tank cap (see Figure 4-2).

**CAUTION**

**U.S. NAVY USER FUEL MUST BE F-76 OR JP-5, FILTERED CLEAR AND BRIGHT.**

**CAUTION**

**DO NOT FILL FUEL TANK BEYOND THE TOP OF THE RED PLUG INSIDE THE FUEL TANK STRAINER.**

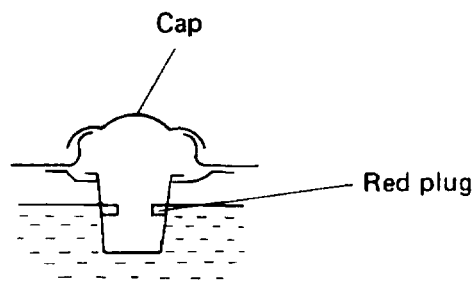


Figure A-2 Fuel tank cap

- d. Fill fuel tank and inspect for leaks.
- e. Replace fuel tank cap.
- f. Return pump unit to readiness condition.

A.1.3 Clean Fuel Filter.  
The fuel filter also has to be cleaned regularly to ensure maximum engine output. U.S. Navy users refer to maintenance index page (MIP) 6641/019. Commercial guidance is as follows:

Clean	Every 6 months or 500 hrs
Replace	Every year or 1000 hrs

**CAUTION**

**F-76 AND JP-5 VAPORS ARE COMBUSTIBLE. WHEN WORKING ON ANY PART OF FUEL SYSTEM, PROVIDE ADEQUATE VENTILATION AND AVOID HIGH HEAT AND OPEN FLAME.**

To clean and inspect fuel tank strainer and replace fuel filter:

- a. Drain fuel from fuel tank through fuel tank drain plug.
- b. Replace fuel tank drain plug.
- c. Remove nuts at fuel cock on underside of the fuel tank.
- d. Remove fuel tank cap, strainer and fuel filter with gasket.
- e. Clean fuel strainer in clean fuel of the type used in the fuel tank, replace if damaged.
- f. Install new fuel filter element with new gasket in fuel tank.
- g. Tighten nuts for fuel filter assembly at fuel tank underside.

**CAUTION**

**DO NOT FILL FUEL TANK BEYOND THE TOP OF THE RED PLUG INSIDE THE FUEL TANK STRAINER.**

- h. Fill fuel tank and inspect for leaks.
- i. Replace fuel tank cap.
- j. Return pump unit to readiness condition.

**A.2 LUBRICATING OIL SYSTEM MAINTENANCE**

**A.2.1. Oil Selection.**

The recommended lubricating oil for commercial use is SAE 10W30, API grade CC or higher for ambient temperatures below 85 degrees F. The specified lubricating oil for U.S. Navy use is MIL-L-2104, equivalent to SAE 15W40. Always use oil with the right viscosity for the ambient temperature in which your engine is being operated.

Nothing affects the performance and durability of your engine more than the lube oil you use. If inferior oil is used, or if your engine oil is not changed regularly, the risk of piston seizure, piston ring sticking, and accelerated wear of the cylinder liner, bearings and other moving components increases significantly. Your engine life may be seriously shortened.

**A.2.2 Clean oil strainer.**

U.S. Navy users refer to maintenance index page (MIP) 6641/019. Commercial guidance is as follows:

Cleaning time	Every 6 months or 500 hrs
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**CAUTION**

**AVOID PROLONGED CONTACT WITH, OR INHALATION OF, CLEANING SOLVENTS. AVOID USE NEAR HEAT OR OPEN FLAME AND PROVIDE ADEQUATE VENTILATION.**

**CAUTION**

**INSPECT AND FILL ENGINE OIL LEVEL ON A LEVEL SURFACE WITH ENGINE STOPPED. CHECKING OIL LEVEL ON A NON LEVEL SURFACE WILL RESULT IN A FALSE READING. OVERFILLING WITH OIL WILL RESULT IN EXCESSIVE OIL CONSUMPTION, HIGH OIL TEMPERATURES, POSSIBLE CRANKCASE EXPLOSION AND ENGINE DAMAGE. INSUFFICIENT OIL LEVELS WILL RESULT ENGINE SEIZURE.**

**WARNING**

**ENGINE SURFACES WILL BE HOT IMMEDIATELY AFTER SECURING THE PUMP. ALLOW SUFFICIENT TIME FOR EXTERNAL SURFACES TO COOL BEFORE HANDLING HOT ENGINE COMPONENTS.**

To clean engine oil strainer

- a. Remove engine oil drain plug from either side of cylinder block and drain oil while engine oil is warm.

**NOTE**

**BE SURE TO DRAIN THE OIL WHILE THE ENGINE IS WARM. LATER, IT MAY BE DIFFICULT TO DRAIN THE OIL COMPLETELY.**

- b. Reinstall plug and tighten.
- c. Loosen lock bolt on strainer cover.
- d. Remove strainer from engine.
- e. Inspect strainer for damage and replace if damaged.
- f. Remove O-ring, clean strainer in cleaning solvent and allow to dry.
- g. Replace O-ring.
- h. Reinstall clean strainer with O-ring.
- i. Install lock bolt on strainer cover and tighten.
- j. Renew engine lube oil.

A.2.3 Change engine lube oil.  
Change engine oil regularly. U.S. Navy users refer to maintenance index page (MIP) 6641/019. Commercial guidance is as follows:

New engine	After first 20 hours or at end of first month
Thereafter	Every 100 hours or three months

- a. Remove engine cap with lube oil gauge.



**CAUTION**

INSPECT AND FILL ENGINE OIL LEVEL ON A LEVEL SURFACE WITH ENGINE STOPPED. CHECKING OR FILLING OIL LEVEL ON A NON LEVEL SURFACE WILL RESULT IN A FALSE READING. OVERFILLING WITH OIL WILL RESULT IN EXCESSIVE OIL CONSUMPTION, HIGH OIL TEMPERATURES, POSSIBLE CRANKCASE EXPLOSION AND ENGINE DAMAGE. INSUFFICIENT OIL LEVELS WILL RESULT ENGINE SEIZURE (see Figure 4-3).

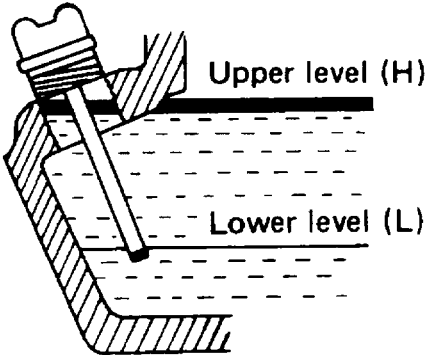


Figure A-3 Engine oil level

- b. Fill engine with oil to the mouth of the filler port.
- c. Replace cap with lube oil gauge and tighten.

**WARNING**

THE ENGINE MAY BE DAMAGED IF OPERATED WITH INSUFFICIENT LUBE OIL. IT IS ALSO DANGEROUS TO SUPPLY TOO MUCH LUBE OIL TO THE ENGINE BECAUSE A SUDDEN INCREASE IN ENGINE RPM COULD BE CAUSED BY ITS COMBUSTION. ALWAYS CHECK THE LUBE OIL LEVEL BEFORE STARTING THE ENGINE AND REFILL IF NECESSARY.

**CAUTION**

WHEN CHECKING THE OIL LEVEL, MAKE SURE YOUR ENGINE IS SITTING LEVEL. IF IT IS TILTED, YOU MAY ADD EITHER TOO MUCH OR TOO LITTLE OIL. IF YOU OVERFILL, YOUR ENGINE WILL CONSUME TOO MUCH OIL AND THE OIL TEMPERATURE WILL BECOME DANGEROUSLY HIGH; IF YOU DO NOT ADD ENOUGH OIL, YOUR ENGINE COULD SEIZE UP.

**A.3 AIR CLEANER SERVICING**

U.S. Navy users refer to maintenance index page (MIP) 6641/019. Commercial guidance is as follows:

Change	Every 6 months or 500 hrs (or earlier if dirty)
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**CAUTION**

**DO NOT WASH THE AIR CLEANER ELEMENT WITH DETERGENT.**

**CAUTION**

**NEVER RUN THE ENGINE WITHOUT THE ELEMENT OR WITH A DEFECTIVE ELEMENT.**

**NOTE**

A CLOGGED ELEMENT HINDERS THE FLOW OF AIR TO THE COMBUSTION CHAMBER. THIS REDUCES ENGINE OUTPUT, INCREASES LUBE OIL AND FUEL OIL CONSUMPTION AND MAKES STARTING DIFFICULT. MAKE SURE YOU CLEAN YOUR ELEMENT REGULARLY.

**A.3.1 Inspect or Replace Air Cleaner Element.**

Inspection of the air cleaner element is recommended every 3 months or 100 hours of operation. Replacement of the air cleaner element is recommended every 6 months or 500 hours of operation. Replacement may be necessary sooner if the operating environment is unusually dusty, etc. Replacement of the seal washer on the air cleaner cover is necessary only if it is damaged.

**NOTE**

**CLEAN, REPAIR, OR REPLACE ANY ITEMS FOUND TO BE EXCESSIVELY DIRTY, WORN, OR DEFECTIVE.**

To inspect or replace air cleaner element:

- a. Remove the wing nut and air cleaner cover.
- b. Remove air cleaner element, inspect for dirt, debris, holes, and tears.
- c. Using a lint free rag, wipe clean inside of air cleaner housing.
- d. Install new air cleaner element, if necessary.
- e. Replace air cleaner cover and tighten wing nut.
- f. Return pump unit to readiness condition.

**A.4 MISCELLANEOUS MAINTENANCE**

U.S. Navy users refer to maintenance index page (MIP) 6641/019. Commercial guidance is as follows:

- a. Tightening Cylinder Head Bolts
- b. Checking the Injection Nozzle, Injection Pump, etc.
- c. Adjusting the valve head clearance for the intake and exhaust valves.
- d. Lapping of intake and exhaust valves.
- e. Replacing piston rings.

All these require special tools and skills, so consult your Yanmar dealer.

## A.5 OPERATIONAL MAINTENANCE

### A.5.1 Drain and Flush Pump Unit.

Each time the pump unit is used to pump seawater, or brackish water, the pump must be flushed with fresh water to prevent salt crystals and oxidation from binding the pump shaft and other pump components that fit together with minimal clearances.

To drain and flush the pump unit:

#### (a) Preferred method of flushing pump unit:

- (1) Open Wye-gate discharge valve and release foot valve flapper to empty the suction hose.
- (2) Open pump casing drain valve and allow pump to stand upright for 3 minutes.
- (3) Close pump casing drain valve and Wye-gate valve.
- (4) Route suction and discharge hoses to a clean 55 gallon drum filled with fresh water.
- (5) Start and operate pump unit in accordance with Chapter 2, Operation. With a 50 psig minimum discharge pressure, operate pump unit for 3 to 5 minutes. Discharge water continuously during operation and replenish the water in the drum while flushing.
- (6) Stop the pump unit and repeat [steps \(1\) and \(2\)](#).
- (7) Disconnect and stow all hoses.
- (8) If temperature is above 32 degrees F (0 degrees C), spray silicone lubricating compound into suction and discharge ports to coat impeller and pump volute.
- (9) Close pump casing drain valve, and replace thread protector caps on suction and discharge fittings (if applicable)
- (10) If temperature is below 32 degrees F (0 degrees C), restart pump unit without connecting the suction and discharge hoses. Open the primer line valve and shift the exhaust primer lever to the prime position for 5 seconds to evacuate any remaining water from the priming line. Immediately stop the pump unit.
- (11) Close pump casing drain valve, and replace thread protector caps on suction and discharge fittings (if applicable)
- (12) Return the pump unit to a state of readiness.

#### (b) Alternate method for flushing pump unit.

- (1) Open Wye-gate discharge valve and release foot valve flapper to empty suction hose.
- (2) Open pump casing drain valve and allow pump to stand upright for 3 minutes.
- (3) Close pump casing drain valve and Wye-gate valve.
- (4) Connect the pump unit to a fresh water source.
- (5) While fresh water is flowing through the pump, depress the compression release lever and slowly pull the recoil starter rope. Repeat 7-10 times to adequately flush any residual seawater from the pump.
- (6) Repeat [step \(1\) and step \(2\)](#).
- (7) Disconnect and stow all hoses.
- (8) If temperature is above 32 degrees F (0 degrees C), spray silicone lubricating compound into suction and discharge ports to coat impeller and pump volute.
- (9) Close pump casing drain valve, and replace thread protector caps on suction and discharge fittings (if applicable)
- (10) If temperature is below 32 degrees F (0 degrees C), restart pump unit without connecting the suction and discharge hoses. Open the primer line valve and shift the exhaust primer level to the prime position for 5 seconds to evacuate any remaining water from the priming line. Immediately stop the pump unit.
- (11) Return the pump unit to a state of readiness.

A.5.2 Visually Inspect Pump Unit.

To visually inspect pump unit:

- a. Inspect pump unit frame.
  - (1) Inspect skids for cracks or damage.
  - (2) Inspect carrying handles for proper operation, damage, loose pins or loose mounting hardware.
  - (3) Inspect engine mounts for cracks, damage or loose bolted connections.
- b. Inspect pump suction, discharge and exhaust threads for damage.
- c. Inspect hoses, tubes, fittings and clamps.
  - (1) Inspect for loose or damaged clamps and fittings.
  - (2) Inspect hoses and tubes for signs of leaks, cracks, kinks, bulges or deterioration.
- d. Inspect recoil starter.
  - (1) Inspect starter housing for cracks or loose mounting hardware.
  - (2) While holding the compression release lever down, slowly pull starter rope fully out and inspect the rope for wear.
  - (3) Inspect starter rope guide for cracks or damage.
- e. Inspect the following controls and indicators for damage and proper operation:
  - (1) Engine speed lever and thumbscrew assembly.
  - (2) Throttle linkage assembly.
  - (3) Fuel cock valve.
  - (4) Exhaust primer shut off valve.
  - (5) Pump drain valve.
  - (6) Compound pressure gage.
  - (7) Fuel level tube.
- f. Inspect exhaust priming assembly.
  - (1) Inspect primer exhaust valve assembly for damage.
  - (2) Inspect exhaust valve discharge for damage or carbon buildup that would prevent exhaust priming.
  - (3) Inspect exhaust priming ejector is free from carbon buildup or obstructions.
- g. Inspect air cleaner for damage or corrosion.
- h. Inspect engine assembly
  - (1) Inspect for leaking gaskets, fittings or seals.
  - (2) Inspect for corrosion of engine castings, covers and mounting and assembly hardware. Inspect stiffening bracket for loose mounting hardware.
  - (3) Inspect flywheel cover and spray shield for damage, corrosion or loose mounting hardware.
- i. Inspect spare tool kit for following items:
  - (1) Adjustable wrench
  - (2) Combination wrenches, 10mm, 12mm, 13mm, 17mm
  - (3) Pliers
  - (4) Tool pouch

A.5.3 Inspect Idle Equipment for Freedom of Movement.

To manually turn engine/pump shaft.

- a. Ensure the fuel cutout valve at the bottom of the fuel tank is in the "S" (closed) position.
- b. Ensure the throttle lever thumbscrew tightened in the STOP position.

### **CAUTION**

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**MANUAL TURNING OF THE SHAFT IS PERFORMED TO REDUCE THE COMPRESSION OF THE PUMP SHAFT PACKING. DO NOT OPERATE THE PUMP UNIT DRY. DO NOT START THE PUMP UNIT WHEN MANUALLY TURNING THE ENGINE/PUMP SHAFT. IMMEDIATELY SECURE THE ENGINE IF THE ENGINE STARTS WHEN PERFORMING THIS PROCEDURE IN ACCORDANCE WITH EMERGENCY STOP PROCEDURES.**

- c. Slowly pull out starter recoil handle until strong resistance is felt and return handle to initial position.
- d. Push down the compression release lever.
- e. Slowly pull out the starter recoil handle for three full extensions of the starter rope.
- f. Pull up the compression release lever.
- g. Return pump unit to readiness condition.

#### A.5.4 Lubricate Pinup Unit.

To lubricate pump unit:

- a. Lubricate throttle pivot points:
  - (1) Apply a thin coat of grease to throttle lever pivot, governor lever pivot and compression release pivot. (Use CAA grease for U.S. Navy pumps)
  - (2) Operate throttle lever to work grease into pivot points. Operate compression release lever to work grease into pivot point.
  - (3) Remove excess lubricant.
- b. Lubricate pump casing drain valve:
  - (1) Apply a thin coat of silicone compound on valve.
  - (2) Open and close valve several times to work in lubrication.
- c. Lubricate suction and discharge connections by applying a thin coat of silicon compound to threads.
- d. Return pump unit to readiness condition.

#### A.5.5 Test Operation of the Pump Unit.

### **WARNING**

---

**DO NOT OPERATE PUMP IN AN ENCLOSED AREA WITHOUT EXHAUST HOSE CONNECTED AND ROUTED SAFELY TO OUTSIDE ATMOSPHERE. EXHAUST GASES CONTAIN CARBON MONOXIDE, WHICH IS ODORLESS AND POISONOUS, AND CAN CAUSE INJURY OR DEATH WHEN INHALED.**

**CAUTION**

**PERSONNEL SHALL WEAR APPROVED HEARING PROTECTIVE DEVICES WHEN ENGINE IS OPERATING.**

A.5.5.1 Preliminary Set Up.

- a. Renew engine fuel prior to pump unit operation.
- b. Move pump unit near water source; remove pump thread protector caps, if installed.
- c. Inspect gaskets on suction and discharge female hose and valve connections. Inspect condition of all threaded connections prior to assembly.

**NOTE**

CHECK SUCTION LIFT PRIOR TO RIGGING PUMP UNIT FOR OPERATION. SUCTION LIFT IS THE VERTICAL DISTANCE FROM THE PUMP SUCTION INLET TO THE FREE SURFACE OF THE WATER BEING PUMPED.

- d. Check distance to water source. If suction lift (vertical height) exceeds 20' an eductor must be used.

**CAUTION**

**DO NOT ATTEMPT TO START OR OPERATE PUMP UNIT BEFORE READING AND THOROUGHLY UNDERSTANDING CHAPTER 2, OPERATION.**

**NOTE**

FOR AMBIENT TEMPERATURES BELOW 30 DEGREES F (0 DEGREES C), REFER TO CHAPTER 2, OPERATION, FOR STARTING AND OPERATING PROCEDURES.

A.5.5.2 Test Operate Pump Unit at Suction Lift < 20 Ft.

**CAUTION**

**A HIGH SPOT AND/OR CLOSE RADIUS BEND IN SUCTION LINE MAY FORM AN AIR TRAP AND PREVENT COMPLETE PUMP PRIMING. ALWAYS ATTACH SUCTION HOSE TO PUMP PRIOR TO PLACING HOSE IN WATER.**

- a. Using spanner wrench, attach a 3" suction line to pump suction fitting. Suction line must consist of required number of 10' lengths of suction hose with a foot valve/strainer unit on submerged end. Make sure all connections are secure. Carefully lower hoses into water making sure foot valve/strainer unit remains submerged at least 1 foot throughout operating period. Make sure suction line slopes continuously downward from pump intake to water.
- b. Attach Wye-gate or Tri-gate to pump discharge fitting. Wye-gate or Tri-gate may be attached to pump discharge fitting by using a short 2-1/2" dia. x 18" extension hose.
- c. Attach one or two 1-1/2 inch hoses and nozzles.

**NOTE**

1-1/2 INCH NOZZLES HAVE A FLOW OF 95 TO 125 GPM AT 100 PSI.

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**WARNING**

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**DO NOT OPERATE PUMP IN AN ENCLOSED AREA WITHOUT EXHAUST HOSE CONNECTED AND ROUTED SAFELY TO OUTSIDE ATMOSPHERE. EXHAUST GASES CONTAIN CARBON MONOXIDE, WHICH IS ODORLESS AND POISONOUS, AND CAN CAUSE INJURY OR DEATH WHEN INHALED.**

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**WARNING**

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**HIGH TEMPERATURES EXIST IN VICINITY OF EXHAUST HOSE CONNECTION AT ENGINE AND AT EXHAUST HOSE DISCHARGE. WEAR FIRE-FIGHTERS GLOVES AT ALL TIMES WHEN HANDLING EXHAUST HOSES.**

- d. If pump unit is to be operated in a poorly ventilated area, attach a maximum of 20' of insulated exhaust hose to exhaust fitting. Do not submerge discharge end of exhaust hose in water. Regularly check exhaust hose connections for leaks.

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**CAUTION**

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**FUEL MUST BE F-76 OR JP-5, FILTERED CLEAR AND BRIGHT.**

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**CAUTION**

---

**DO NOT FILL FUEL TANK BEYOND THE TOP OF THE RED PLUG INSIDE THE FUEL TANK STRAINER.**

- e. Inspect engine fuel level. Fill if low. Do not overfill. Do not put oil in fuel tank.

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**CAUTION**

---

**INSPECT ENGINE OIL LEVEL ON A LEVEL SURFACE WITH ENGINE STOPPED. CHECKING OIL LEVEL ON A NON-LEVEL SURFACE WILL RESULT IN A FALSE READING. OVERFILLING WITH OIL WILL RESULT IN EXCESSIVE OIL CONSUMPTION, HIGH OIL TEMPERATURES, POSSIBLE CRANKCASE EXPLOSION AND ENGINE DAMAGE. INSUFFICIENT OIL LEVELS WILL RESULT ENGINE SEIZURE.**

- f. Inspect engine oil level. Fill if low. Do not overfill.
- g. Close discharge valve at discharge head.
- h. Set fuel isolation valve at bottom of fuel tank to "O" (open) position.
- i. Place throttle lever so indicator is in START position and tighten thumbscrew.

**NOTE**

**PRIMER SHUT-OFF VALVE IS OPEN WHEN LEVER IS IN LINE WITH HOSELINE.**

- j. Open primer line shut-off valve between primer ejector assembly and pump suction.
- k. Slowly pull out starter recoil handle until strong resistance is felt and return handle to initial position.
- l. Push down the compression release lever.

**WARNING**

**PERSONNEL SHALL WEAR APPROVED HEARING PROTECTIVE DEVICES WHEN ENGINE IS OPERATING.**

- m. Pull the recoil starting handle briskly with both hands to start engine.
- n. If engine does not start repeat steps k. through m.

**CAUTION**

**DO NOT CONTINUE TO OPERATE THE PUMP UNIT IF PRIMING CAN NOT BE ACHIEVED WITHIN TWO MINUTES. SHUTDOWN ENGINE AND TROUBLESHOOT FOR CAUSE OF FAILURE TO ACHIEVE PRIME.**

- o. Once the engine is running, set the engine throttle control to the "RUN" position.

**NOTE**

**START THE ENGINE AND RUN AT A FAST IDLE TO PRIME WITH LIFTS LESS THAN 10 FEET. START THE ENGINE AND RUN AT FULL THROTTLE TO PRIME WITH 10 TO 22 FOOT LIFTS.**

- p. Shift the exhaust valve to the prime position blocking the main exhaust opening. The exhaust valve is in the prime position when the handle is horizontal.
- q. When a steady stream of water appears at the discharge of the priming jet, close the primer line shut-off valve and return the engine exhaust valve to the normal position. Open the pump discharge valve.
- r. Repeat the priming operation if the pump fails to hold its prime. If the pump does not deliver water within two minutes, stop the engine and check for air leaks at suction connections and/or the pump packing gland, or failure of the priming jet to produce vacuum.

**CAUTION**

**DO NOT OPERATE PUMP UNIT CONTINUOUSLY WITHOUT DISCHARGING WATER. OPERATION OF THE PUMP WITH A CLOSED DISCHARGE VALVE WILL RESULT IN OVERHEATING OF AND DAMAGE TO THE PUMP. AT A MINIMUM, BLEED A SMALL AMOUNT OF WATER FROM A SECONDARY DISCHARGE HOSE WHEN THE PUMP IS OPERATING AND THE PRIMARY HOSE AND NOZZLE ARE SECURED.**



### CAUTION

**OBSERVE EXHAUST SMOKE COLOR AFTER PRIMING HAS BEEN ACHIEVED AND PUMP IS DISCHARGING WATER. EXHAUST SMOKE COLOR SHOULD BECOME CLEAR OR LIGHT BLUISH AS THE ENGINE WARMS UP. IN HIGH LOAD SITUATIONS, THE CONTINUED APPEARANCE OF BLACK EXHAUST SMOKE AFTER THE ENGINE HAS WARMED UP INDICATES OVERFUELING OF THE ENGINE. OVERFUELING OF THE ENGINE WILL CAUSE FUEL DILUTION OF THE LUBE OIL AND ENGINE DAMAGE WITH CONTINUED OPERATION. ADJUSTMENT OF THE THROTTLE TO REDUCE ENGINE LOAD IS REQUIRED IF EVIDENCE OF ENGINE OVERFUELING IS OBSERVED.**

- s. Slowly open a single 1-1/2" hose discharge line on Wye-gate or Tri-gate valve and discharge water from hose nozzle.

### **NOTE**

PUMP SHAFT PACKING DRIP RATE SHOULD BE 5-60 DROPS PER MINUTE (60 DROPS PER MINUTE MAXIMUM). LOWER DRIP RATE INDICATES EXCESSIVE TIGHTENING OF PUMP SHAFT PACKING. HIGHER DRIP RATE INDICATES INSUFFICIENT PACKING ADJUSTMENT. ADJUST PUMP PACKING DRIP RATE PER STUFFING BOX ADJUSTMENT SECTION (U.S. NAVY USERS ACCOMPLISH MRC R-3, IF REQUIRED).

- t. Observe pump shaft packing drip rate with pump unit discharging water. Packing drip rate should be 5-60 drops per minute (60 drops per minute maximum)
- u. Operate pump unit (5 minutes minimum) long enough to inspect for the following:
  - (1) Unusual noise or vibration.
  - (2) Proper discharge pressure (85-100 psig) when operating a single 1-1/2" fire hose with nozzle.
  - (3) Leakage from pump or accessories other than shaft packing gland drip. Secure pump unit as required to correct causes of leakage in accordance with the technical manual

### **NOTE**

IF PUMP UNIT FAILS TO SHUTDOWN WHEN THROTTLE LEVER IS PLACED IN THE "STOP" POSITION, REFER TO STEP 3, EMERGENCY STOP PROCEDURES.

- v. Secure the pump unit by loosening the throttle lever thumbscrew and moving the lever to the "Stop" position.
- w. Drain and flush the pump unit, return it to the state of readiness. U.S. Navy users accomplish MRCs R-1 and R-18.

#### A.5.5.3 Test Operate Pump at Suction Lift > 20 Ft.

### CAUTION

**A HIGH SPOT AND/OR CLOSE RADIUS BEND IN SUCTION LINE MAY FORM AN AIR TRAP AND PREVENT COMPLETE PUMP PRIMING. ALWAYS ATTACH SUCTION HOSE TO PUMP PRIOR TO PLACING HOSE IN WATER.**

- a. Attach 1-1/2" hose to eductor charging port, using 1-1/2" x 2-1/2" adapter if required.

- b. Attach foot valve assembly to eductor inlet, using adapter if required.
- c. Using a spanner wrench, attach 3" suction line to eductor outlet connection, using adapter if required.
- d. Using spanner wrench, attach a 3" suction line to pump suction fitting. Suction line assembly must consist of required number of 10' lengths of suction hose, sufficient length of eductor charging hose and a foot valve/strainer unit and eductor on submerged end. Make sure all connections are secure. Carefully lower hoses into water making sure eductor and foot valve/strainer unit remains submerged at least 1 foot throughout operating period. Make sure suction line slopes continuously downward from pump intake to water.
- e. Attach Tri-gate valve to pump discharge fitting. Tri-gate may be attached to pump discharge fitting by using a short 2-1/2" dia. x 18" extension hose.
- f. Attach eductor charging hose to one of the 1-1/2" Tri-gate discharge ports. Leave eductor charging line cut out valve on Tri-gate open.
- g. Ensure one 1-1/2" port of Tri-gate is closed and fill the eductor charging hose and suction hose with water from fire-main or potable water source through the remaining port.

**NOTE**

1-1/2 INCH NOZZLES HAVE A FLOW OF 95 TO 125 GPM AT 100 PSI.

- h. Attach a 1-1/2" hose with nozzle to Tri-gate valve.
- i. Ensure 1-1/2" Tri-gate shut off valve is closed.

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**WARNING**

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**DO NOT OPERATE PUMP IN AN ENCLOSED AREA WITHOUT EXHAUST HOSE CONNECTED AND ROUTED SAFELY TO OUTSIDE ATMOSPHERE. EXHAUST GASES CONTAIN CARBON MONOXIDE, WHICH IS ODORLESS AND POISONOUS, AND CAN CAUSE INJURY OR DEATH WHEN INHALED.**

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**WARNING**

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**HIGH TEMPERATURES EXIST IN VICINITY OF EXHAUST HOSE CONNECTION AT ENGINE AND AT EXHAUST HOSE DISCHARGE. WEAR FIRE-FIGHTERS GLOVES AT ALL TIMES WHEN HANDLING EXHAUST HOSES.**

- j. If pump unit is to be operated in a poorly ventilated area, attach a maximum of 20' of insulated exhaust hose to exhaust fitting. Do not submerge discharge end of exhaust hose in water. Regularly check exhaust hose connections for leaks.

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**CAUTION**

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**FUEL MUST BE F-76 OR JP-5, FILTERED CLEAR AND BRIGHT.**

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**CAUTION**

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**DO NOT FILL FUEL TANK BEYOND THE TOP OF THE RED PLUG INSIDE THE FUEL TANK STRAINER.**

- k. Inspect engine fuel level. Fill if low. Do not overfill. Do not put oil in fuel tank.

#### **CAUTION**

**INSPECT ENGINE OIL LEVEL ON A LEVEL SURFACE WITH ENGINE STOPPED. CHECKING OIL LEVEL ON A NON-LEVEL SURFACE WILL RESULT IN A FALSE READING. OVERFILLING WITH OIL WILL RESULT IN EXCESSIVE OIL CONSUMPTION, HIGH OIL TEMPERATURES, POSSIBLE CRANKCASE EXPLOSION AND ENGINE DAMAGE. INSUFFICIENT OIL LEVELS WILL RESULT ENGINE SEIZURE.**

- l. Inspect engine oil level. Fill if low. Do not overfill.
- m. Close discharge valve at discharge head.
- n. Set fuel cutout valve at bottom of fuel tank to "O" (open) position.
- o. Place throttle lever so indicator is in START position and tighten thumbscrew.

#### **NOTE**

**PRIMER SHUT-OFF VALVE IS OPEN WHEN LEVER IS IN LINE WITH HOSELINE.**

- p. Open primer line shut-off valve between primer ejector assembly and pump suction.
- q. Slowly pull out starter recoil handle until strong resistance is felt and return handle to initial position.
- r. Push down the compression release lever.

#### **WARNING**

**PERSONNEL SHALL WEAR APPROVED HEARING PROTECTIVE DEVICES WHEN ENGINE IS OPERATING.**

#### **CAUTION**

**A STRONG DELIBERATE PULL IS REQUIRED TO PREVENT ENGINE KICK-BACK AND POSSIBLE STARTING IN THE REVERSE ROTATIONAL DIRECTION. IF THIS DOES OCCUR, IMMEDIATELY SHUT DOWN THE ENGINE. OPERATION IN THE REVERSE DIRECTION IS CHARACTERIZED BY THE EVIDENCE OF EXHAUST GASES COMING OUT OF THE INTAKE FILTER. REVERSE OPERATION DOES NOT ALLOW FULL POWER OPERATION, POSITIVE PRIMING, AND WILL CAUSE DAMAGE TO THE UNIT.**

- s. Pull the recoil starting handle briskly with both hands to start engine.
- t. If engine does not start repeat steps q. through s. Once engine is running, set the throttle control to the "RUN" position.

#### **CAUTION**

**DO NOT CONTINUE TO OPERATE THE PUMP UNIT IF PRIMING CAN NOT BE ACHIEVED WITHIN TWO MINUTES. SHUTDOWN ENGINE AND TROUBLESHOOT FOR CAUSE OF FAILURE TO ACHIEVE PRIME.**

**NOTE**

START THE ENGINE AND RUN AT A FAST IDLE TO PRIME WITH LIFTS LESS THAN 10 FEET. START THE ENGINE AND RUN AT FULL THROTTLE TO PRIME WITH 10 TO 22 FOOT LIFTS.

- u. Shift the exhaust valve to the prime position blocking the main exhaust opening. The exhaust valve is in the prime position when the handle is horizontal.
- v. When a steady stream of water appears at the discharge of the priming jet, close the primer line shut-off valve and return the engine exhaust valve to the normal position. Open the pump discharge valve.
- w. Repeat the priming operation if the pump fails to hold its prime. If the pump does not deliver water within two minutes, stop the engine and check for air leaks at suction connections and/or the pump packing gland, or failure of the priming jet to produce vacuum.

**CAUTION**

**DO NOT OPERATE PUMP UNIT CONTINUOUSLY WITHOUT DISCHARGING WATER. OPERATION OF THE PUMP WITH A CLOSED DISCHARGE VALVE WILL RESULT IN OVERHEATING OF AND DAMAGE TO THE PUMP. WHEN OPERATING WITH AN EDUCTOR, RECIRCULATION OF WATER THROUGH THE EDUCTOR CHARGING LINE IS SUFFICIENT TO ENSURE FLOW IS MAINTAINED UNTIL WATER IS DISCHARGED FROM THE 1-1/2" HOSE AND NOZZLE.**

**CAUTION**

**OBSERVE EXHAUST SMOKE COLOR AFTER PRIMING HAS BEEN ACHIEVED AND PUMP IS DISCHARGING WATER. EXHAUST SMOKE COLOR SHOULD BECOME CLEAR OR LIGHT BLUISH AS THE ENGINE WARMS UP. IN HIGH LOAD SITUATIONS, THE CONTINUED APPEARANCE OF BLACK EXHAUST SMOKE AFTER THE ENGINE HAS WARMED UP INDICATES OVERFUELING OF THE ENGINE. OVERFUELING OF THE ENGINE WILL CAUSE FUEL DILUTION OF THE LUBE OIL AND ENGINE DAMAGE WITH CONTINUED OPERATION. ADJUSTMENT OF THE THROTTLE TO REDUCE ENGINE LOAD IS REQUIRED IF EVIDENCE OF ENGINE OVERFUELING IS OBSERVED.**

- x. Slowly open a single 1-1/2" hose discharge line on Tri-gate valve and discharge water from hose nozzle.

**NOTE**

PUMP SHAFT PACKING DRIP RATE SHOULD BE 5-60 DROPS PER MINUTE (60 DROPS PER MINUTE MAXIMUM). LOWER DRIP RATE INDICATES EXCESSIVE TIGHTENING OF PUMP SHAFT PACKING. HIGHER DRIP RATE INDICATES INSUFFICIENT PACKING ADJUSTMENT.

- y. Observe pump shaft packing drip rate with pump unit discharging water. Packing drip rate should be 5-60 drops per minute (60 drops per minute maximum)
- z. Operate pump unit (5 minutes minimum) long enough to inspect for the following:
  - (1) Unusual noise or vibration.
  - (2) Proper discharge pressure (minimum 45 psig) when operating a single 1-1/2" fire hose with nozzle.

- (3) Leakage from pump or accessories other than shaft packing gland drip. Secure pump unit as required to correct for causes of leakage in accordance with the technical manual

**NOTE**

IF PUMP UNIT FAILS TO SHUTDOWN WHEN THROTTLE LEVER IS PLACED IN THE STOP POSITION, REFER TO STEP 3, EMERGENCY STOP PROCEDURES.

- aa. Secure the pump unit by loosening the throttle lever thumbscrew and moving the lever to the "Stop" position.
- bb. Drain and flush the pump unit, return it to the state of readiness. U.S. Navy users accomplish MRCs R-1 and R-18.

A.5.5.4 Emergency Shutdown Procedures.

**NOTE**

PERFORM EMERGENCY SHUTDOWN PROCEDURES IN THE ORDER PROVIDED. PERFORM CORRECTIVE MAINTENANCE TO FIND CAUSE OF FAILURE OF ENGINE TO SHUTDOWN IN ACCORDANCE WITH THE TECHNICAL MANUAL BEFORE ATTEMPTING TO OPERATE THE PUMP UNIT.

- a. Close fuel cut out valve at base of fuel tank.
- b. If necessary, push down engine compression release lever.
- c. Cover air intake assembly with rags or suitable material to restrict air to the engine.

**A.6 STOW FOR LONG TERM SHUTDOWN.**

**CAUTION**

**AVOID PROLONGED CONTACT WITH, OR INHALATION OF, CLEANING SOLVENTS. AVOID USE NEAR HEAT OR OPEN FLAME AND PROVIDE ADEQUATE VENTILATION.**

To stow for long term shutdown:

- a. Drain and flush pump
- b. Clean oil filter/Renew lube oil
- c. Clean suction and discharge adapter with solvent degreaser. Replace thread protector caps.

**WARNING**

**F-76 AND JP-5 VAPORS ARE COMBUSTIBLE. WHEN WORKING ON ANY PART OF FUEL SYSTEM, PROVIDE ADEQUATE VENTILATION AND AVOID HIGH HEAT AND OPEN FLAME.**

- d. Drain fuel from fuel tank through fuel tank drain plug.
- e. Wipe clean engine, frame and pump assemblies with solvent degreaser.

- f. Wrap pump unit in fire resistant paper and seal thoroughly using pressure sensitive tape.
- g. Place pump unit in storage area.

A.6.1 To Restore Unit Readiness After Long Term Storage.  
To remove protective cover.

- a. Remove pump unit from storage.
- b. Remove fire resistant paper from exterior of pump unit.
- c. Remove thread protector caps from pump suction and discharge adapters.
- d. Lubricate pump unit.

**CAUTION**

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**FUEL MUST BE F-76 OR JP-5, FILTERED CLEAR AND BRIGHT WITH NO MORE THAN 2 MILLIGRAMS PER LITER (MG/L) OF SOLIDS AND NO MORE THAN 5 PARTS PER MILLION (PPM) OF WATER.**

**CAUTION**

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**DO NOT FILL FUEL TANK BEYOND THE TOP OF THE RED PLUG INSIDE THE FUEL TANK STRAINER.**

- e. Fill engine fuel tank with fuel.
- f. Return pump unit to readiness condition.

## A.7 INJECTION TYPE STUFFING BOX ADJUSTMENT

Only use Garlock style #926-AFP plastallic packing material. It is made of shredded composition lead foil, non-asbestos fibers, and a special bonding compound containing lubricant and graphite. W. S. Darley compresses this material into 5/8" dia. x 1" long pellets (3817102) which are packed 23 to a box. It is Darley part no. 3817101.

It is important that the stuffing box is completely filled solid with packing and compressed firm during adjustment to prevent formation of voids and excessive leakage.

To pack the stuffing box when empty and assembled in the pump, remove the packing screw and nut assembly, and insert pellet form packing into the packing plunger guide. Replace the packing screw assembly and use a hand speed wrench to force the pellets into the gland. **DO NOT USE A POWER TOOL!** Repeat pellet additions while turning the impeller shaft by hand until resistance to turning is felt when the stuffing box is almost full. Continue turning packing screw by hand using a standard 6" long 9/16" end wrench until 4 lb. of force is felt at the end of the wrench. This is equivalent to 2 ft-lb or 24 in-lb torque. Continue turning until a few flakes of packing are extruded out the opening between the impeller shaft and the stuffing box hole. A 2BE10YDN pump unit requires six 3817102 packing pellets. The gland is now ready for pressure testing or pumping.

After priming the pump with water, start the pump and raise the discharge pressure to 50 psi. Tighten the packing screw using a 6" long 9/16" end wrench until 4 lb. force is felt at the end of the wrench (24 in-lb torque). Continue operating the pump at 50 psi for 5 minutes to dissipate packing pressure against the shaft and permit cooling water to flow between the shaft and stuffing box hole. Make sure that water actually does come through before operating pump at any higher pressure. The normal drip rate may vary between 5 and 60 drops per minute.

Operate the pump for 10 minutes at the highest normal operating pressure flowing sufficient water to prevent overheating. Do not run pump blocked tight. Lower discharge pressure to 50 psi. and repeat the packing screw tightening procedure outlined above.

The pump may now be operated for any time period required within its rated capacity. However, the drip rate should be monitored more frequently during the first few hours, and adjusted if necessary to achieve a stable flow rate. Several more adjustments may be required.

## **A.8 CORROSION PROTECTION**

The pump end of the P-100 is constructed entirely of light weight, corrosion resistant materials. It is expected that no special treatment will be required to maintain the pump end, in terms of corrosion protection.

The standard Yanmar engine requires corrosion protection measures to ensure that it will withstand the rigors of the marine environment. The fuel tank, fan case, and recoil starter have been primed with a phosphorized oxidized iron primer followed by two coats of Melamine Alkyd enamel. The air cleaner has been primed with a phosphorized oxidized iron primer and finished with a baked on epoxy top coat by Yanmar.

The aluminum engine block, fuel injector, injector pump, and all other engine components not treated by Yanmar have been subjected to the DuPont IMRON paint system. The IMRON coating system is a commercially available, four step process; cleaning, conditioning, priming, and top coating. A specific DuPont product and application procedure is used for each step. This product offers up to three times the protection of conventional air dry enamels and therefore, it is not recommended to use other paints to touch up any scrapes or scratches occurring during operation.

Periodically inspect pump unit for scrapes, scratches, peeling, or corrosion. Repaint only when necessary, especially on heat transfer surfaces such as the engine block. Refer requests for repainting of paint units to Intermediate Maintenance Activity. Onboard stowage of the IMRON coating is not authorized.





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